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Dispositional Optimism and Autonomic Reactivity During

Difficult and Easy Stress Tasks

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Dissertation submitted

to the Eberly College of Arts and Sciences

at West Virginia University

in partial fulfillment of the requirements for the degree of

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ABSTRACT

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Studies examining the association between dispositional optimism and autonomic reactivity to stress have yielded mixed results, with some studies finding associations between optimism and less reactivity, some studies finding no association between optimism and reactivity, and some finding that optimism was associated with greater reactivity. One factor not considered previously in this literature is difficulty of the stressful task employed to elicit autonomic reactivity. The current study was based on Carver and Scheier's Behavioral Self-Regulation Model (Carver & Scheier, 2000), that states that optimists are more likely to persist in overcoming challenging obstacles than pessimists. The current study investigated whether the relation between optimism and autonomic reactivity to stress differed depending on the difficulty of the stressful task. This study employed a quasi-experimental design in which participants were classified as optimists or pessimists based on their score on a validated measure of optimism. Participants were randomized to complete either an easy Raven's Matrices stress task or a difficult Raven's Matrices stress task. Blood pressure (systolic, diastolic, mean arterial), heart rate, and heart rate variability were measured throughout the pre-task rest period, the task period, and a recovery period. It was hypothesized that optimists would exhibit increased cardiovascular reactivity when confronting a difficult stress task compared to pessimists, due to fully engaging their resources to overcome the task. Conversely, pessimists were hypothesized to exhibit less cardiovascular reactivity during the difficult task, because they were not fully engaged in solving the problems. No differences in cardiovascular reactivity between optimists and pessimists were hypothesized during the easy task, because both groups would be equally engaged with the task.

Results revealed that optimists had greater diastolic blood pressure reactivity to both the easy and difficult stress tasks compared to pessimists, suggesting they may have been more engaged with the tasks compared to pessimists. Indeed, optimists reported being more persistent in completing the problems and performing better on them compared to pessimists. Analysis of affective responses to the tasks showed that optimists reported more positive affect and less negative affect than pessimists during the laboratory session. However, there were no differences between optimists and pessimists on task performance, ratings of task self-efficacy, and ratings of task difficulty, stressfulness, discomfort, or perceived effort. Significant task effects were revealed as well, verifying that the easy and difficult tasks were experienced differently. Participants completing the difficult task performed more poorly, reported less positive and more negative affect in response to the task, and rated the task as more difficult, stressful, effortful, and upsetting than participants completing the easy task. Although results of the study failed to confirm study hypotheses, they added credence to the Behavioral Self-Regulation Model because optimists appeared to be engaging more with both easy and difficult versions of the stress task than pessimists, and consequently, experienced greater DBP reactions during the task period than pessimists.

TABLE OF CONTENTS

Dispositional Optimism and Autonomic Reactivity During Difficult and Easy Stress Tasks

The influence of psychosocial factors on physical health is well documented. For several decades, evidence demonstrating that negative psychosocial factors, including depression, anxiety, hostility, social isolation, and chronic stress are related to poor physical health has accrued. For example, depression and social isolation are both related to increased risk of all-cause mortality (e.g., House, Landis, & Umberson, 1988; Zivin et al., 2015). Both depression and anxiety are related to increased experience of chronic pain and increased disability related to chronic pain (e.g., Lerman, Rudich, Brill, Shalev, & Shahar, 2015). Depression, anxiety, and social isolation are also linked to poorer prognosis following the diagnosis of several chronic diseases (Boden-Albala, Litwak, Elkind, Rundek, & Sacco, 2005; Chan, Wan Ahmad, Yusof, Ho, & Krupat, 2015; Noyes Jr, & Kathol, 1985).

Negative psychosocial factors also specifically influence cardiovascular health. For example, depression, anxiety, social isolation, chronic life stress, and hostility each contribute to the etiology of coronary artery disease (CAD; e.g., Rozanski, Blumenthal, & Kaplan, 1999; Shimbo et al., 2009; Whooley & Wong, 2013). Depression, anxiety, hostility, and social isolation are also related to increased initial cardiac events among community samples and higher mortality rate among patients already diagnosed with CAD (e.g., Barth, Schumacher, & Herrmann-Lingen, 2004; Roest, Martens, Denollet, & de Jonge, 2010; Wong, Sin, & Whooley, 2014). Despite the importance of considering psychosocial risk factors along with the standard risk factors for CAD (i.e., sex; family history of CAD; smoking; hypercholesterolemia, hypertension, diabetes), considerable variance in predicting onset of CAD remains unexplained. This has led toward the examination of additional constructs that may be useful in predicting the negative health consequences associated with CAD.

Recently, evidence that positive psychosocial factors are associated with improved physical health has been accumulating. For example, those with high levels of social support have better health outcomes than those with low social support (Uchino, 2006). Specifically, high social support is related to lower mortality caused by cancer, infectious diseases, and cardiovascular disease. Forgiveness is also linked to improved health; following a traumatic injury, those who forgave the person responsible for the accident experienced faster recovery and improved health status than those who did not engage in forgiveness (Webb, Toussaint, Kalpakjian, & Tate, 2010). Furthermore, numerous constructs from positive psychology, including forgiveness, emotional vitality, social support, and optimism, have all been linked to a decreased risk of developing CAD (Tay, Tan, Diener, & Gonzalez, 2013; Tindle et al., 2009; Waltman, et al., 2009). The proposed study aims to examine one of these constructs, dispositional optimism, by exploring the proposed physiological mechanisms through which it could exert its salubrious effects on cardiovascular health.

Dispositional Optimism and its Associated Health Benefits

Dispositional optimism is a positive psychosocial trait that has received considerable attention. Dispositional optimism is defined as a pattern of expecting that, in the future, good things will be more abundant than bad things (Scheier & Carver, 1992). Optimists generally expect the future to be favorable, and believe that they are capable of obtaining their goals (Scheier & Carver, 1992). Conversely, those low in optimism expect future outcomes to be less positive, and believe that their goals may not be entirely obtainable. Dispositional optimism is most frequently measured using the Life Orientation Test or the Life Orientation Test – Revised (LOT and LOT-R, respectively; Scheier & Carver, 1992), a 10-item self-report scale. Many theorists have conceptualized the LOT/LOT-R as representing a single construct, with high and low scores falling on a single continuum of "optimism" (i.e., low optimism is equivalent to pessimism). However, several investigators have found that the LOT/LOT-R has a two-factor structure, each measuring distinct constructs of optimism and pessimism (Kubzansky, Kubzansky, & Maselko, 2004; Raikkonen, & Matthews, 2008; Scheier, Carver, & Bridges, 1994). From this perspective, being low on optimism does not necessarily translate into being pessimistic. Based upon this conceptualization of this positive psychology construct, developers of the LOT/LOT-R have recommended that initial "total optimism score" analyses should be followed by analyzing the optimism and pessimism subscales separately (Scheier et al., 1994). Although several studies have found that the LOT/LOT-R has two separate factors, the majority of research examining the relation between optimism and health has utilized the LOT/LOT-R as a measure of a single construct (Rasmussen, Scheier, & Greenhouse, 2009). Optimism as a construct is conceptually and inversely related to other personality traits such as neuroticism and trait anxiety, and it has been suggested that these variables be included as covariates when assessing relations between optimism and health (Scheier et al., 1994; Kennedy & Hughes, 2004).

The health benefits related to dispositional optimism are well documented. For instance, in a longitudinal study by Peterson, Seligman, and Vaillant (1988), 99 healthy male graduates of Harvard University were followed from age 25 to age 60 years. Those with high levels of optimism had better overall health and lower mortality rates 30 years later than males with low optimism scores. Evidence also suggests that optimism may increase immune functioning. Using a self-report weekly stress log, Cohen et al. (1999) found that during weeks with high levels of acute stress (e.g., stressors lasting less than one week), immune markers such as CD4 helper t-cell and CD8 cytotoxic t-cell counts were significantly higher among individuals with high dispositional optimism (Cohen et al., 1999). Similarly, among law students in their first semester of law school, optimistic students were found to have better immune functioning (e.g., higher numbers of helper T cells and higher natural killer cell cytotoxicity) than less optimistic students (Segerstrom, Taylor, Kemeny, & Fahey, 1998). Optimism may also influence pulmonary functioning; among men aged 45-89 years, those with high optimism had a slower decline in pulmonary functioning than those with low optimism over the course of approximately 10 years (Kubzansky et al., 2002).

While dispositional optimism clearly is associated with a broad range of positive health outcomes, the best-documented association between optimism and health is the link between optimism and cardiovascular-related health outcomes. Substantial evidence from prospective studies confirms that having an optimistic disposition is associated with reduced risk of cardiovascular disease (CVD). A longitudinal study that followed initially healthy males (mean age 60.8 years) in a community sample showed that those who were optimistic were less likely to have developed or died from CVD 10 years later than those with low scores on optimism (Kubzansky, Sparrow, Vokonas, & Kawachi, 2001). Lower rates of CVD and death due to CVD have also been found among post-menopausal women high in optimism aged 50-79 years who were followed for approximately eight years (Tindle et al., 2009). Indeed, some evidence suggests that having high dispositional optimism may be associated with a reduction in risk of CVD by up to 50% (Boehm & Kubzansky, 2012). While being optimistic is associated with a reduction in the likelihood that one will develop CVD in the future, it also is associated with better prognosis after developing the disease; cardiac patients high in optimism have fewer subsequent cardiac events, lower cardiovascular-related mortality rates, report less pain, have fewer complications, and recover more quickly than those low in optimism following myocardial infarction and/or cardiac surgery (e.g., Grewen et al., 2000; Mahler, & Kulik, 2000; Scheier, & Carver, 1987).

Mechanisms through which Optimism Improves Health

The relation between dispositional optimism and physical health, especially cardiovascular health, is well established. However, the specific mechanisms through which optimism influences health are unknown. One possible mechanism by which optimism influences physical health is through the range and type of coping strategies an individual uses to manage stress. According to Carver and Scheier (2000), when an obstacle is encountered, individuals typically assess the likelihood that they can overcome the obstacle. Because optimists believe they can obtain their goals, they are more likely to approach and strive to overcome obstacles. Less optimistic individuals may not believe they are able to overcome obstacles, and are therefore less likely to attempt to overcome them. Indeed, optimistic individuals tend to use approach-focused coping strategies, in which they work to overcome or remove the stressor by dealing with it directly, more than other coping strategies (Billingsley, Waehler, & Hardin, 1993; Scheier, Weintraub, & Carver, 1986). Optimists may also use problem-focused coping strategies when faced with health-related obstacles. For example, if optimists know that they have a family history of heart disease (obstacle), they are more likely to address the obstacle directly by exercising or eating a healthy diet, so that health can be maintained (goal). Conversely, pessimists who have family histories of heart disease may be less likely to see future health as attainable, and therefore, be less likely to engage in preventive measures.

Another clue to how optimism may improve health is found in the relation between optimism and health behaviors. Dispositional optimism has been linked to higher levels of physical activity, greater consumption of nutrient-rich foods, and lower levels of tobacco use (e.g., Giltay, Geleijnse, Zitman, Buijsse, & Kromhout, 2007; Kelloniemi, Ek, & Laitinen, 2005). Health behaviors engaged in by optimists may be conceptualized as approach-style coping strategies in which a desired health outcome is the goal. Consequently, it is likely that the improved cardiovascular health observed among optimists is related to their adherence to a healthier lifestyle.

Several researchers have suggested a third mechanism through which dispositional optimism influences health outcomes: the magnitude and pattern of one's autonomic nervous system response to stress. The autonomic nervous system consists of the sympathetic branch and the parasympathetic branch, both of which are responsive to exposure to stress (McEwen & Stellar, 1993). In brief, during stress, both branches of the autonomic nervous system interact, resulting in increased blood pressure (BP), respiration rate, sweating on the hands and feet (resulting in increased electrical skin conductance), dilation of the pupils, accelerated heart rate (HR), and decreased gastro-intestinal activity and heart-rate variability (HRV). Multiple studies have demonstrated that the magnitude of one's autonomic response (especially cardiovascular response) to stress is predictive of future cardiovascular disease (e.g., Carroll et al., 2012; Krantz & Manuck, 1984; Treiber et al., 2003). Furthermore, prolonged elevation of cardiovascular parameters following a stressful experience (i.e., delayed recovery) is also indicative of future cardiovascular disease (e.g., Chida & Steptoe, 2010; Steptoe & Marmot, 2005). Thus, those whose autonomic nervous systems exhibit the highest reactivity during stress and slowest recovery to resting levels following stress are more likely to develop CVD.

Several researchers have examined the possibility that the link between optimism and physical health is due, at least in part, to lower autonomic reactivity and/or quicker autonomic recovery when exposed to stress among those high in optimism. Because BP and HR reactivity to stress are the most closely linked to future CVD, most of the research on this topic has focused on these two indicators of autonomic reactivity. However, other indices of autonomic activity, such as skin conductance, have also been examined in relation to dispositional optimism.

Optimism and Decreased Autonomic Reactivity to Stress

In all, 13 studies completed between 1990 and 2017 have examined the relation between dispositional optimism and attenuated autonomic reactivity to stress. Of these studies, 11 assessed autonomic parameters during an acute laboratory stressor and two assessed ambulatory blood pressure over an extended period of time. BP, HR, and skin conductance are the only autonomic parameters that have been examined in these studies. A brief description of each of these 13 studies follows.

Williams, Riels, and Roper (1990) were the first to examine the association between optimism and BP response to stress. Fifty-six undergraduate students completed both a mental arithmetic stress task, during which their mistakes were corrected, and a Simon® stress task, during which the participant replicated a pattern of lights displayed as quickly as possible. Both stress tasks were six minutes in duration and were preceded by rest periods. They found that those high in dispositional optimism had lower diastolic blood pressure (DBP) reactivity during the mental arithmetic stress task only, in comparison to those low in optimism. Optimism did not influence systolic blood pressure (SBP) or HR reactivity during the mental arithmetic task, and did not affect SBP, DBP, or HR reactivity during the Simon® stress task. The authors concluded that their results supported the hypothesis that the mechanism through which dispositional optimism was associated with improved health could be reduced autonomic reactivity to stress (Williams et al., 1990).

Eleven years later, Segerstrom (2001) examined the relation between optimism and attentional bias. Forty-seven undergraduate students completed an “emotional Stroop task” containing words with emotional valence (positive or negative). They found that when words with negative emotional meaning were presented, optimism was negatively related to skin conductance, indicating less autonomic arousal. However, when words with positive emotional meaning were presented, the association between optimism and skin conductance was positive, (albeit a weaker relation than when negative stimuli were presented). The authors noted, however, that after controlling for trait anxiety, the interaction between optimism and emotional content of the words was no longer significant in predicting skin conductance reactivity.

In 2004, Kennedy and Hughes (2004) sought to replicate the findings of Williams et al. (1990) and explore neuroticism as a possible moderator of the relation between optimism and BP/HR reactivity to an acute laboratory stressor. After a rest period, each of the 50 female undergraduate participants completed a brief (3 minute) mental arithmetic task (without correction of mistakes), followed by a 5-minute recovery period. They found no differences between high-optimists and low-optimists in SBP, DBP, or HR reactivity or recovery during or after the stress task. The main effect for optimism was not significant either with or without neuroticism included as a covariate. However, they found that neuroticism was directly related to both SBP and DBP reactivity during the stress task. They concluded that dispositional optimism did not influence BP or HR reactivity during stress, but that other personality variables, such as neuroticism, may be underlying factors that account for any optimism-stress reactivity relations observed in prior work (Kennedy & Hughes, 2004).

Following the recommendation by Kennedy and Hughes (2004) to examine the relation between dispositional optimism and stress reactivity in light of other variables, several later studies included various moderator variables in their examination of the association between dispositional optimism and reactivity to stress. Bonfiglio (2005) examined the moderating effects of social support on the optimism-stress reactivity relation. After a rest period, all 85 female undergraduate participants completed a five minute mental arithmetic task during which they were instructed to "work faster and more accurately." The author found that neither optimism nor social support was associated with SBP, DBP, or HR reactivity during stress. Furthermore, dispositional optimism and social support did not interact to influence BP or HR reactivity to stress. Dispositional optimism was also unrelated to SBP, DBP, or HR recovery following the stress task.

Contrary to the majority of researchers examining the optimism-autonomic arousal association, Nes, Segerstrom, and Sephton (2005) predicted that optimists, in contrast to pessimists, were likely to engage more and persist in a task longer when their goals were viewed as obtainable (see Carver and Scheier, 2000), and therefore experience more autonomic nervous system (HR and skin conductance) reactivity to a stressor. They also hypothesized that this relation would be moderated by self-awareness (measured by the Self-Consciousness Scale), which makes one's current status related to goals more salient. If one was optimistic and aware of their current standing with their goals, they would be more likely to persist and have greater arousal. Fifty-four undergraduates completed a 20-minute anagram stress task compromised of 11 anagrams, of which the first was insoluble, and the remaining 10 were solvable and of moderate difficulty. Optimism was not associated with either HR or skin conductance reactivity to the anagram task. During recovery, however, optimism interacted with self-awareness to predict skin conductance recovery; optimism was associated with slower skin conductance recovery, but only for those participants in the high self-awareness condition.

One year later, Clark, Benkert, and Flack (2006) examined how optimism and history of violence exposure interacted to predict BP and HR reactivity to stress. One-hundred seventy-two black youth (mean age of 11.5 years) underwent a 10-minute rest period followed by a six minute digits-forward and digits-backward recollection task. Using the Perceived Life Chances Scale (Jessor, Donovan & Costa, 1996) as an index of optimism, they found that optimism alone was not a significant predictor of SBP, DBP, or HR reactivity to stress. However, dispositional optimism moderated the effect of violence exposure on both SBP and HR reactivity to the task. For those high in optimism, violence exposure was inversely related to SBP reactivity. For those low in optimism, no relation between violence exposure and SBP reactivity was observed. However, for those low in optimism, violence exposure was positively related to HR reactivity to stress, while no relation was observed for those high in optimism.

Richman, Bennett, Pek, Siegler, and Williams, (2007) examined the association between several variables (optimism, race, past discrimination, trait-hostility) and cardiovascular reactivity to stress. Participants from a community sample consisting of 165 adults (ages 18-50) completed a 5 minute "stress" task during which they were supposed to recall and relate a personal experience that made them very angry. While they did not find a main effect of optimism on any cardiovascular reactivity parameter, they found a three-way interaction between race, perceived discrimination, and optimism on DBP reactivity to the anger-recall task. DBP *increased* among participants who had high perceived past discrimination and were high in optimism, and this relation was more pronounced among black participants. While there was no main effect of dispositional optimism on BP or HR reactivity or recovery, the observed interaction is contrary to the hypothesis that optimism is associated with reduced cardiovascular reactivity to stress.

Later, Geers, Wellman, Helfer, Fowler, and France (2008) examined the relation between dispositional optimism and pain. They hypothesized that priming participants with either "health" or neutral primes would influence reactivity to the task. Seventy-two undergraduate participants underwent a 10-minute rest period, followed by a sentence-scramble task and a two-minute cold-pressor task. Their results indicated that high dispositional optimism was associated with lower HR reactivity to the cold-pressor task; however, this finding was qualified by a significant interaction between optimism and prime condition on HR reactivity. High optimism was associated with lower HR reactivity only in the neutral primed group. A similar interaction between optimism and prime condition for DBP was observed; high optimism was related to lower DBP reactivity only in the group that received the neutral prime.

Terrill, Ruiz, and Garofalo (2010) sought to determine if the buffering effect of optimism on cardiovascular reactivity to stress depended on the nature of the stressor. Ninety undergraduate participants completed both a three-minute cold-pressor task and an 8-minute social speech task (3 minutes mental rehearsal, 5 minutes of speech delivery) during which they related a personally embarrassing experience in front of a video camera. When subscales of the LOT-R were analyzed separately, higher optimism was linked to less MAP reactivity to the mental rehearsal portion of the speech task. The authors also noted that optimism had a marginal inverse association with DBP reactivity during mental rehearsal ($p = 0.06$). Furthermore, higher optimism was associated with faster SBP and MAP recovery following the speech task. The authors commented that given their results, the cardiovascular benefits of optimism (e.g., attenuated BP response and faster BP recovery) may only be present during social stress, as opposed to non-social stressors.

Puig-Perez et al. (2015) examined the association between optimism and HR response to a stressor among an older sample (ages: 55-76 years). Participants were randomized into either a stress group or a control group. In the stress group, participants completed a 10-minute Trier Social Stress Task (TSST), in which they gave a 5-minute speech about why they were a good job candidate, followed by five minutes of serial subtraction, both performed in front of two confederate observers. The control group task involved giving a five-minute speech about a neutral topic, followed by five minutes of easy serial addition. In the control group, neither task was performed in front of a committee. Puig-Perez et al. (2015) first ran their analyses with a total LOT-R score, and did not find significant results. However, when running separate analyses for optimism and pessimism subscales, they found that optimism, but not pessimism, was related to HR reactivity. They found that optimism had a negative association with HR reactivity in both the stress group and the control group during the task. Optimism was not linked with faster HR recovery following the task.

Most recently, Puig-Perez, Hacket, Salvador, and Steptoe (2017) exposed 140 participants with Type II Diabetes to a laboratory stress task. Participants completed both a five-minute Stroop color-word task and a five-minute mirror-trace stress task. SBP, DBP, and HR were assessed throughout the tasks. They found that optimism was related to increased SBP and DBP reactivity during the stress task.

Two other studies examining autonomic reactivity as a possible mechanism through which optimism increases health have employed ambulatory assessment methods instead of using a laboratory stressor (Räikkönen & Matthews, 2008; Räikkönen, Matthews, Flory, Owens, & Gump, 1999). In both of these studies, measures of BP were obtained during daily living on samples of 201 adolescents aged 14-16 years (Räikkönen & Matthews, 2008) and 100 adults, aged 30-45 years (Räikkönen et al., 1999). Both studies found that dispositional optimism was associated with reduced ambulatory blood pressures over several days. Räikkönen and Matthews (2008) found that, when experiencing daily stress, however, optimists' BP was just as elevated as that of pessimists.

Overall, studies examining the relation between optimism and autonomic reactivity to stress have reported mixed findings. Some studies found support for relations between dispositional optimism and attenuated physiological reactivity to stress (e.g., Geers et al., 2008; Puig-Perez et al., 2015; Terrill et al., 2010; Williams et al., 1990), but others failed to find any relation between optimism and physiological response parameters (e.g., Bonfiglio, 2005; Kennedy & Hughes, 2004). Still other studies found that the relation between optimism and physiological response to stress was moderated by a third variable (e.g., Clark et al., 2006; Segerstrom, 2001). Finally, three studies found support for an association between optimism and increased reactivity to and delayed recovery from stress (Nes et al., 2005; Richman et al., 2007; Puig-Perez et al., 2017). Based upon this constellation of findings, the question of whether optimism is associated with attenuated autonomic reactivity remains largely unanswered.

The literature examining the relation between optimism and autonomic response to stress cited above has several weaknesses that warrant attention. For example, only seven of the 13 studies reviewed controlled for (either experimentally or statistically) extraneous variables that were relevant to physiological assessment (e.g., sex, BMI), or the optimism construct itself (other personality characteristics such as trait anxiety, neuroticism, etc.). Furthermore, only seven of the 13 studies controlled for other important variables that are known to influence autonomic activity, such as caffeine, nicotine, and prescription drug use prior to the experiment. Also, the majority of studies did not analyze pessimism and optimism subscales of the LOT/LOT-R separately as suggested by Scheier and colleagues (1994). In at least two cases (Puig-Perez et al., 2015; Terrill et al., 2010), no association was observed between LOT/LOT-R total score and autonomic reactivity parameters, but an association emerged once subscale scores were analyzed.

The Behavioral Self-Regulation Model

As noted above, three studies contained in this literature found that optimists' autonomic systems were *more* reactive to a stressor in certain situations (Nes et al., 2005; Richman et al., 2007; Puig-Perez et al., 2017). This finding is conceivable in light of Carver and Scheier's (2000) behavioral self-regulation model. According to this model, optimists are more likely to employ approach-focused coping when faced with a stressor; they engage in efforts to reduce or eliminate strains induced by a stressor to overcome it as a barrier. Accordingly, when optimists believe that their desired goals are attainable, they are likely to put forth more effort to reach their goals compared to persons low in optimism or high in pessimism (Carver & Scheier, 2000). Research has shown that pessimists are more likely to give up when their goals are blocked than optimists because they do not see their desired goals as attainable (e.g., Carver, Lehman, & Antoni, 2003; Strack, Carver, & Blaney, 1987).

Based upon this Behavioral Self-Regulation Model, it follows that during times of stress, particularly during especially difficult stressors, optimists may experience greater autonomic arousal than pessimists as they attempt to solve the problems they are confronting. From this perspective, task difficulty may be an important factor that has yet to be explored in this literature. It seems likely that the degree to which optimists and pessimists react to a given challenge would depend upon its perceived difficulty or solvability. Indeed, research supports the idea optimists and pessimists react and perform differently during stressors of varying difficulty. During particularly difficult tasks, optimists tend to perform better than pessimists. For example, Seligman and Schulman (1986) studied job performance among insurance salesman, an especially stressful job. They found that optimistic insurance agents sold approximately 27% more insurance plans compared to pessimistic agents during a specific time period. Helton, Dember, Warm, and Matthews (1999) also found that optimists performed better than pessimists on a particularly difficult computerized vigilance task. Seligman and Schulman (1986) also found that optimists were more persistent in difficult tasks; the pessimistic insurance agents quit their jobs at twice the rate of optimistic agents. Nes et al. (2005) also found that optimists persisted longer on a difficult anagram task compared to pessimists. In contrast, these performance and persistence differences between optimists and pessimists are not typically observed while engaging in easy tasks. Werenfels (2006) had optimists and pessimists complete three trials of a relatively easy clerical checking task, and found no performance differences. Similarly, Geers et al. (2008) employed a cold-pressor task (although uncomfortable, this is a simple task), and found no difference in length of time that optimists and pessimists persisted in the task.

The Behavioral Self-Regulation Model and Reactivity to Stress Tasks

It follows that during a very difficult and challenging stressor, optimists are likely to fully engage behavioral and cognitive resources to overcome the stressor, which may result in a significant increase in autonomic activity. In contrast, pessimists are less likely to fully engage all of their resources during a particularly difficult stressor, perhaps resulting in a smaller increase in autonomic activity during the stressor. When confronting tasks that are easily solved, optimists may not differ from pessimists on measures of physiological reactivity because they will continue to exert effort to solve the problem at hand and the pessimists may engage more fully in solving easy problems.

Unfortunately, studies that have examined optimism and autonomic reactivity to acute stress have employed various laboratory stressors without considering difficulty of the task. Stressors examined included mental arithmetic (Williams et al., 1990; Kennedy & Hughes, 2004; Bonfiglio, 2005), digit-forward/digit backward (Clark et al., 2006), Simon® (Williams et al., 1990), anger experience recall (Richman et al., 2007), cold pressor (Geers et al., 2008; Terril et al., 2010), delivery of a speech (Puig-Perez et al., 2015; Terril et al., 2010), Stroop word-color task (Puig-Perez et al., 2017; Segerstrom, 2001), and anagram tasks (Nes et al., 2005). All of these tasks have been shown to elicit BP and HR reactivity in prior studies, so they represent appropriate methods for eliciting cardiovascular reactivity to stress in the studies that comprise this literature (Krantz, Manuck, & Wing, 1986; Tuomisto, Majahalme, Kahonen, Fredrikson, & Turjanmaa, 2005). However, all of these tasks were developed for purposes of eliciting a consistent level of task performance across an entire task period by maintaining constant attention to the mental task. Consequently, tasks employed in this literature were not devised for use in studies where exposure to tasks of varying levels of difficulty was desired. In fact, with the exception of the first anagram problem presented in Nes et al.'s study that was described as "insolvable," all other stimuli used in these studies were presented as solvable to study participants if they exerted some degree of effort on the task. Interestingly, the Nes et al. study was one of the two studies in this literature that demonstrated a slower recovery in skin conductance response among participants high in optimism, albeit only those with high self-awareness. Congruent with the Behavioral Self-Regulation Model, it is possible that participants low in optimism in this study gave up early and consequently recovered more quickly from the stressful task. Because the role of task difficulty has yet to be examined with respect to the relation between optimism and cardiovascular reactivity to stress, a task amenable to modification on the basis of task difficulty was required.

In the current study, puzzles from Raven's Progressive Matrices intelligence test were used as stimuli for the stress task (Raven, Raven, & Court, 2004; see *Stress Task Development* section of the study method for details). The Raven's Progressive Matrices test includes a range of puzzles that vary widely in difficulty, allowing for the creation of difficult and easy versions of stress tasks that contain similar stimulus formats and task instructions. Additionally, the Raven's Matrices test is considered an active coping task in that each participant has instrumental control over the outcome (i.e., good or poor performance) and is known to elicit beta-adrenergic responses to stress (Hollenberg, Williams, & Adams, 1981; Larkin, Polefrone, & Francis, unpublished report). Because Raven's Matrices stimuli have been used to measure intelligence, a digit-symbol task (Wechsler, 2008), which has also been used to assess intelligence, was completed. Scores on the digit-symbol task were used as a covariate to account for the effects of intelligence on Raven's Matrices task performance.

Aims of the Proposed Study

The purpose of the proposed study was twofold. First, because the current literature assessing the association between dispositional optimism and autonomic reactivity to stress has significant shortcomings and findings have been mixed regarding study outcomes, this study sought to explore the association between optimism and cardiovascular reactivity to stress by addressing several of the shortcomings of previous studies. Second, this study sought to test Carver and Scheier's Behavioral Self-Regulation Model, which hypothesizes that optimists, compared to pessimists, are likely to engage more with mental tasks (and potentially experience more autonomic arousal) when their goals are blocked by obstacles. The results of this study aimed to explain why previous studies examining optimism and autonomic reactivity have exhibited mixed findings. Participants high and low in optimism were recruited from the student population at West Virginia University. To test whether participants high and low in optimism reacted differently based on the difficulty of the stressor, half of the study participants completed a highly difficult stress task while the other half completed a stress task of low difficulty. Based upon the Behavioral Self-Regulation Model, during the high difficult task, we hypothesized that participants high in optimism would use approach-focused coping and display more autonomic reactivity and slower recovery than those low in optimism, who would be more likely to disengage from a difficult task. Evidence for task engagement was examined by comparing task performance scores of high and low optimism participants. In response to the difficult task, we expected high optimism participants to perform better than those low in optimism. In contrast, during the easy task, we hypothesized that there would be no difference in autonomic reactivity or recovery between participants high and low in optimism because both groups would be equally engaged and view puzzles as solvable.

Method

Participants

One hundred fifty-two participants were recruited from undergraduate classes at West Virginia University. Participants were excluded if they smoked or used any kind of tobacco, had any chronic major health concerns (i.e., heart disease, cancer, diabetes), or were taking medications that influenced heart rate or blood pressure. Participants were asked via email to abstain from caffeine, alcohol, and vigorous exercise for two hours prior to the experimental session.

The sample size for this study was determined using G*Power 3.1.9.2, by entering the study design as "a priori, ANCOVA: Fixed effects, main effects, and interactions," with an effect size of f = .2723, α = .05, and power of .80. This effect size was obtained from Puig-Perez et al., (2015), in which optimism accounted for 6.9% of the variance in HR reactivity (R^2 = .069 converts to an effect size f of .2723). This effect size represented a medium effect size, which was consistent with effect sizes reported by other studies that examined the relation between optimism and autonomic reactivity to stress. The power analysis indicated that a sample size of 152 was needed to detect an effect size of this magnitude.

Participants were selected from a screening sample of 1167 students enrolled in undergraduate courses based upon their scores on the LOT-R. The total screening sample consisted of 938 women and 229 men. In regard to racial composition, 44 identified as African American, 40 identified as Asian (Chinese, Korean, Japanese, Filipino, Indian), 992 identified as White, 66 identified as mixed race, 13 identified as other race, one identified as Native American or Alaskan Native, and 11 declined to answer. A tertile split of all participants completing the LOT-R was performed. Results indicated that participants scoring 22 or above were considered high in optimism (i.e., optimists) and participants scoring 17 or below were considered low in optimism (i.e., pessimists). Two previous studies examining optimism and cardiovascular reactivity selected participants based on their LOT-R scores, similar to the current study (Bonfiglio, 2005; Kenedy & Hughes, 2004). Bonfiglio considered participants pessimists if their LOT-R scores were less than or equal to 12, and optimists if their LOT-R scores were greater than or equal to 18. Kennedy and Hughes did not report cut-offs for their groups, but the mean LOT-R score of their pessimist group was 8.93 (*SD* = 2.8) and the mean LOT-R score of the optimist group was 20 (*SD* = 1.64). Compared to optimist and pessimist groups employed in these prior studies, the sampling distribution of students examined in the current study was more optimistic.

Of the 152 participants who completed the laboratory portion of the study, 130 were women and 22 were men. In regard to race/ethnicity, eight identified as African American, eight identified as Asian, 124 identified as White, seven identified as mixed race, one identified as American Indian or Alaskan Native, one identified as other race, and three declined to answer. Comparisons of the groups invited to participate in the experimental session revealed that optimists had a mean LOT-R score of 24.99 (*SE* = .26), and pessimists had a mean LOT-R score of 13.33 (*SE* = .29). When broken down into study groups, the optimist group completing the difficult task had 32 women and five men, of which 29 were White, three were African American, one was Asian, two were mixed race, and 1 identified as Other race. The optimists completing the easy task consisted of 32 women and five men, of which 32 were White, two were African American, two were Asian, and one declined to answer. Among the pessimists completing the difficult task, 33 were women and six were men, of which 31 were White, one was African American, two were Asian, three were mixed race, and two declined to answer. Among the pessimists completing the easy task, 33 were women and six were men, among which 32 were White, two were African American, three were Asian, and two were mixed race.

Measures

***Blood pressure*.** An *Industrial and Biomedical Sensors, Inc*. Model SD-700A (Waltham, MA) automated sphygmomanometer was used to measure SBP, DBP, and MAP. This device uses an automated occluding cuff positioned on the brachial artery of the participants' non-dominant arm to detect Kortokoff sounds (via a microphone), ensuring accurate BP measurement. Maximum cuff inflation was set at 165 millimeters of Mercury (mm Hg) and rate of deflation was set at 3 mm Hg per sec.

Heart rate (HR). HR was measured using a *Polar* heart rate monitor Model 810i (Lake Success, New York). This device measures HR continuously throughout data collection by sending ECG signals from a sensor strapped around the participants' chest to a receiver attached to a computer. Three measures of heart rate variability (HRV) were determined from the continuous HR signals: standard deviation of the normal sinus interbeat interval-to-normal sinus interbeat interval (SDNN); low frequency (LF) HRV, and high frequency (HF) HRV. Kubios HRV v2.0 software was used to examine HR signals for clarity and conduct the spectral waveform analyses (Niskanen et al., 2004).

Self-report measures

Demographic form**.** A short demographic form used in previous studies in the Behavioral Physiology Laboratory (e.g., Stephenson, 2015) was used in this study. This questionnaire includes items pertaining to age, sex, height, weight, race/ethnicity, year in school, and parental socioeconomic status. In regard to parental socioeconomic status, an adaptation of the MacArthur Subjective Social Status Ladder, which has been used in numerous studies as a measure of subjective SES and has demonstrated good construct validity (Cundiff, Smith, Uchino, & Berg, 2013), was used. Participants are asked to imagine a ladder representing social/economic status of families in the United States, including factors such as money, education, and respected jobs. Those higher on the ladder have more money, more education, and more respected jobs. Participants were asked to identify which rung of the ladder (there are 10 rungs) their respective family falls. The form also includes general questions about participants' health status and behaviors (See Appendix B).

Life Orientation Test – Revised (LOT-R). The LOT-R is a six-item questionnaire (with four additional distractor items) designed to assess dispositional optimism (Scheier, Carver, & Bridges, 1994). The creators of the LOT-R intended it to assess a single construct of optimism. However, some have argued that that a two-factor model, with optimism and pessimism factors, fit the data better (Chang and McBride-Chang 1996; Glaesmer et al., 2012; Robinson-Whelen et al. 1997), while others have argued a single factor fits the data better and makes better conceptual sense (Rauch, Schweizer, & Moosbrugger, 2007; Scheier et al., 1994). Scheier et al. (1994) suggests that total LOT-R scores should be followed-up by analyzing optimism and pessimism subscales separately. The LOT-R total score has demonstrated good internal consistency (alpha = 0.78) and test-retest reliability (28-month correlation = 0.79; Scheier et al., 1994). Individual optimism and pessimism subscales, each containing 3 items, also demonstrate good internal consistency (alpha = 0.70, alpha = 0.74, respectively; Glaesmer et al., 2012). The LOT-R has also demonstrated acceptable discriminant validity, sharing only modest amounts of variance with conceptually similar constructs such as neuroticism, trait anxiety, and self-esteem (Scheier et al., 1994). In the current study, the LOT-R total score demonstrated good internal consistency (alpha = 0.90). The optimism and pessimism subscales also demonstrated good internal consistency (alphas = 0.78 and 0.90, respectively) in the current study.

State-Trait Anxiety Inventory (STAI). The STAI has both state and trait anxiety subscales. For the purposes of this study only the trait anxiety subscale was used, which is comprised of 20 items. The trait anxiety subscale of the STAI has previously demonstrated good internal consistency (alpha = 0.90) and good test-retest reliability (30-day correlation = 0.73; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). The trait anxiety subscale also demonstrated good concurrent validity and discriminant validity, as evidenced by its strong association with the IPAT Anxiety Scale and the Manifest Anxiety Scale, and its weak associations with other personality factors on the Edwards Personal Preference Checklist (a personality inventory) and school aptitude (e.g., GPA, class rank, etc.; Spielberger et al., 1983). In the current study, the trait anxiety subscale of the STAI demonstrated good internal consistency (alpha = 0.94).

Big Five Inventory (BFI-2). The BFI-2 is a 60-item questionnaire that assesses the Big Five personality domains: Extraversion, Agreeableness, Conscientiousness, Negative Emotionality, and Open-Mindedness. Additionally, it assesses 15 more-specific facet traits. Each item is a brief adjective or description of an attribute or interest; the participant is instructed to endorse to what degree the adjective/description describes him or her on a five-point Likert-type scale. All five domain scales have demonstrated alpha reliabilities over 0.83, and test-retest reliability of at least 0.76 (Soto & John, 2016). In the current study, all subscales demonstrated good internal consistency: Extraversion (alpha = 0.88), Agreeableness (alpha = 0.82), Conscientiousness (alpha = 0.84), Neuroticism (alpha = 0.90), and Openness to Experience (alpha = 0.80). The BFI-2 has demonstrated good discriminant and concurrent validity as evidenced by strong correlations with corresponding personality traits on the NEO Personality Inventory. For purposes of the proposed study, only the (Negative Emotionality) Neuroticism scale was used.

Multiple Affect Adjective Checklist-Revised (MAACL-R). The MAACL-R (Zuckerman & Lubin, 1985) is a checklist-type questionnaire containing 66 adjectives describing state and/or trait affect. Participants were asked to complete the MAACL-R after the completion of the recovery phase, and asked to indicate how they felt during the stress task. This measure traditionally has five sub-scales: Anxiety, Depression, Hostility, Positive Affect, and Sensation

Seeking. However, evidence suggests the MAACL-R may be better represented with a two-factor model: positive affect and negative affect (Hunsley, 1990). For the purpose of this study, the two-factor model was utilized. This scale has demonstrated good concurrent validity as evidenced by strong correlations with similar state affect scores on the State Trait Personality Inventory, Sensation Seeking Scale, and Affect Balance Scale. It has also demonstrated good discriminant validity as evidenced by weak associations with less similar constructs also measured by these scales (Lubin, Van Whitlock, Reddy, & Petren, 2001).

Self-efficacy Questionnaire. The purpose of this questionnaire was to ensure the participants' understanding of the types of puzzles they encountered during the stress task and to assess confidence in their ability to complete the task. The self-efficacy questionnaire included a sample item from the Raven's Matrices (Raven, Raven, & Court, 2004), similar to the items that they would encounter during the stress task. It then instructed participants to rate how confident they are that they will be able to complete all of the items during the stress task accurately. Participants responded to this item on a four-point Likert type scale. This questionnaire was designed specifically for the proposed study. Although its psychometric characteristics have not been reported, it was formatted based on similar self-efficacy scales in the literature.

Post-Task Questionnaire. The post-task questionnaire consisted of items that assessed the stress level experienced during the task, perceived difficulty of the task, and other factors related to the participants' experiences during the stress task.

Digit-Symbol Task. The digit-symbol task is a simple task which is a component of several well-known IQ tests, including the Wechsler Adult Intelligence scale (WAIS; Wechsler, 2008). This task is a measure of processing speed, a major component of IQ. Participants are given a coding key and a series of numbers, and must record the corresponding symbol for as many numbers in the series as they are able in 90 seconds. The digit-symbol task has shown good test-retest reliability (*r* = 0.74 over an 80-day period; Morrison, Simone, Ng, & Hardy, 2015). This measure was included in order to account for the influence of participants' intelligence on task completion. The score from this task was used as a covariate in analyses examining the stress task score.

Experimental design

This study employed a quasi-experimental design. The independent variables of interest were optimism level of participant (optimist, pessimist), and difficulty of stress task (difficult vs. easy). Participants were assigned to the optimism or pessimism group based on their LOT-R total score; participants scoring in the top and bottom tertiles were invited to participate in the laboratory portion of the study. Participants were assigned to complete either the difficult or the easy stress task based on a random number generator after they arrived in the laboratory.

Stress task development and pilot testing

Raven's Matrices puzzles were obtained from the Standard Progressive Matrices Sets A, B, C, D, and E test booklet (Raven, 1998). Puzzles from these sets range in difficulty, with easier puzzles occurring toward the beginning of each set and more difficult puzzles toward the end of each set. Fourteen puzzles that were judged by the researcher to be easy and 14 that were judged to be difficult were selected to be piloted for consideration as test stimuli for the primary study. During both the pilot and experimental portions of the study, all Raven's Matrices were presented electronically on a *Dell* Inspiron (Model 1525) laptop computer. Eight graduate students in the Department of Psychology completed the 28 puzzles (difficult and easy) and the duration for stating an answer was timed for each puzzle. The average time to answer the easy puzzles was approximately seven seconds (ranged from 5.1 - 14.9 seconds), while the average time to answer the difficult puzzles was approximately 28 seconds (ranged from 13.6 - 36.9 seconds). Based upon these data showing that all easy puzzles were completed in less than 16 sec and most difficult puzzles took longer than 16 sec to complete, a 16-sec response interval was selected for all 28 puzzles, followed by a five sec period in which the participant was instructed to state their answer aloud and the researcher would inform them whether it was correct or not.

Data were collected on two graduate students using the timing selected to determine if 16 seconds was a sufficient amount of time for each puzzle to be displayed. The graduate student who completed the difficult stress task was unable to correctly answer any of the puzzles correctly, and reported that the time limit (16 seconds) was not enough time to grasp any of the patterns. The graduate student who completed the easy stress task correctly answered 13 out of 14 puzzles.

Out of concern that the puzzle-viewing period (16 seconds) was too short to solve the difficult puzzles, we decided to compare viewing 14-puzzles (seeing each puzzle for 16 seconds) with viewing 12-puzzles (seeing each puzzle for 20 seconds) on a sample of 10 undergraduate students. We asked five pilot participants who completed the difficult task whether the allotted time was enough time to come up with an answer, whether they were able to at least eliminate 2-3 of the possible answers, and how difficult the task was on a scale of 1-10. We asked five pilot participants who completed the easy task if they were able to solve the puzzle during the first 5-8 seconds, or if it took them the entire time to get the answer. They were also asked what they did during the remaining time if they got the answer in the first 5-8 seconds. Finally, they were asked how difficult the task was on a scale of 1-10.

For the three students who completed the difficult stress task with 14 puzzles, the average number of correctly solved puzzles was 1.66. They reported that 16 seconds was not enough time to complete the puzzle, that they only had enough time to eliminate 1 of 8 possible answers, and that the task was judged a 10 out of 10 on the scale of difficulty. For the three students who completed the easy stress task with 14 puzzles, the average number of correctly solved puzzles was 10.66. They indicated that they were able to solve most of the puzzles in the first 5-8 seconds, and that they double-checked their answer during the remaining time. They said the task was a 4-5 on a 1-10 scale of difficulty.

Two students completed the difficult stress task using the 12-puzzle format. On average, they correctly solved two puzzles. They indicated that 20 seconds was enough time to solve a few of the puzzles, but it was not enough time to solve many of them. They indicated that 20 seconds was enough time to eliminate 2-3 of the possible alternatives. They rated the difficulty as 8-9 on a 10-point scale. The two students who completed the easy stress task with 12 puzzles both correctly solved all 12 puzzles. Both indicated that it took them approximately 10 seconds to solve each puzzle, and that they used the remaining time to check their answer. They rated the difficulty as 3-4 on a 10-point scale.

Based upon these pilot data, it was determined that 16 seconds was not a long enough duration to solve any of the difficult puzzles. To ensure that participants did not become discouraged during the difficult task, the 12-puzzle format was adopted in which each puzzle appeared for 20 seconds for both easy and difficult matrices.

Procedure

Participants completed the demographic and other pertinent questionnaires online using the SONA system. Those who scored either in the top or bottom tertile on the LOT-R and met all other inclusion criteria (no medications that would affect cardiovascular activity, etc.) were invited to schedule a session in the Behavioral Physiology Laboratory. Upon entering the laboratory, the participant met the experimenter, was dressed in a white lab coat and behaved in a professional manner. The experimenter described the study, went over potential risks and benefits with the participant, and obtained his/her informed consent using an approved consent agreement. Then, the experimenter measured the height and weight of the participant and confirmed that he or she had abstained from caffeine, alcohol, and exercise for the previous two hours. The experimenter then left the room so the participant could attach the *Polar* heart rate monitor around his or her chest privately. The experimenter attached the blood pressure cuff to the participants' non-dominant upper arm and HR and BP signals were examined to assure clarity. Participants were then instructed to sit quietly with both feet on the floor for a 15-minute rest period. Blood pressure measurements began eight minutes into the rest period and were taken every two minutes for the remainder of the rest period and HR was measured continuously during the rest period.

Following completion of the rest period, participants were provided instruction about how to complete the problems on the Raven's Matrices stress task and, after viewing the sample problem, completed the self-efficacy questionnaire. Once the experimenter gave the participant the signal to begin, the participant pressed a single key on a laptop computer, which launched the stress task. As noted above, participants were randomly assigned to receive either the easy or difficult version of the task. In both the easy and difficult stress tasks, each puzzle appeared for 20 seconds, followed by a screen that stated "Answer?" for five seconds. During the 20 second period in which the puzzle was shown, the participant was expected to attempt to solve the puzzle. Task performance was monitored by watching the participant through a one-way mirrored window and listening to answers on an intercom. When they saw “Answer?” screen, they were instructed to state their answer aloud so that the experimenter could record it and provide them verbal feedback (e.g., “correct” or “incorrect) regarding their answer via an intercom. After the screen that prompted them to give their answer was displayed for five seconds, this screen disappeared and the next puzzle was presented. Both the difficult and easy stress tasks contained a total of 12 puzzles and lasted five minutes. Both tasks were completed in an identical manner using identical instructions and format, so that the only difference between conditions was level of difficulty of the puzzles. BP was measured during the first, third, and fifth minutes of the task period and HR was measured continuously.

Following the completion of the stress task, participants sat quietly for a five-minute recovery period. BP and HR measures were obtained in an identical manner to measures during the task period. Following the recovery period, participants completed the post-task questionnaire and the MAACL-R. They were then given instructions and completed the 90-second digit-symbol task. Following the digit-symbol task, experimental apparatuses were detached and participants were debriefed and paid $10 for their time.

Results

Data Cleaning and Reduction

Invalid or questionable measures of BP were removed using the criteria outlined by Marler, Jacob, Lehoszky, and Shapiro (1988). Accordingly, SBPs below 70 mm Hg or above 250 mm Hg or DBPs below 45 mm Hg or above 150 mm Hg were replaced with the most proximate valid BP value within that experimental period. Furthermore, when pulse pressure between a SBP and its paired DBP was less than 30 mm Hg, BPs that were inconsistent with their proximate BPs were replaced with the mean of two proximate, valid BPs. A total of 37 BP measurements (out of 2980 total BP measurements or approximately 1% of BP measures) were flagged as questionable and replaced according to these criteria.

Heart rate data were analyzed for artefacts using the *Polar* 810i software set at a low filtering level. This software replaces erroneous HR values typically observed when participants move excessively or the signal from the *Polar* Monitor is momentarily lost. HRs were then calculated for each minute during the rest, task, and recovery periods. It should be noted that complete HR data were not obtained for three participants.

Preliminary Analyses

***Rest Period*.** One way repeated measures ANOVAs were conducted to examine variation that might occur in each cardiovascular parameter across each minute of the rest period (See ANOVA Summary Tables 1-6 in Appendix B). Analysis of resting SBP, $F(2, 302) = 1.92$, $p = 0.148$, resting DBP, $F(2, 302) = 0.84$, $p = 0.435$, and resting MAP, $F(2, 302) = 0.32$, $p = 0.730$, revealed no significant main effects, so BP values during the rest period were averaged to arrive at a mean resting level for each parameter (i.e., resting SBP, resting DBP, resting MAP). In contrast, the repeated measures ANOVA on resting HR revealed a significant main effect, $F(2, 298) = 6.08$, $p = 0.003$, $\eta_p^2 = 0.039$. Follow-up mean comparisons showed that HR during minute 10 (76.05 bpm) was significantly lower than HR during minute 14 (77.07 bpm). These differences did not indicate any systematic change in HR across the baseline period, so all HRs were averaged to yield a single resting HR measure.

Because assessment of HRV is unreliable across durations as brief as one minute, interbeat intervals from all valid HR values during the rest period were subjected to HRV analysis, producing one measure at rest for each HRV parameter (SDNN, HF, LF). By convention, all HF and LF measures throughout the experiment were transformed using logarithmic transformations in order to normalize distributions for purposes of analysis.

Task Period. For purposes of analyzing cardiovascular reactivity to the task, measures of HR and BP were averaged across minutes to obtain average cardiovascular reactions to the entire Raven's Matrices task. Like the rest period, a single measure for each SDNN, HF, and LF was determined for the task period. To confirm that participants reacted to the Raven's Matrices tasks with increased autonomic activity, Group (Easy, Difficult) X Period (Rest, Task) mixed factors ANOVAs were conducted for each cardiovascular parameter (See ANOVA Summary Tables 7-19 in Appendix B). For SBP, the main effect of Period was significant, $F(1, 150) = 149.18$, $p = 0.000$, $\eta_p^2 = 0.499$. SBP was higher during the stress task ($M = 118.4$ mm Hg, $SE = 0.97$), than during the rest period ($M = 111.5$ mm Hg, $SE = 0.87$). The Group X Period interaction effect, $F(1, 150) = 0.229$, $p = 0.633$, $\eta_p^2 = 0.002$ was not significant, indicating no significant difference in SBP reactivity between those completing the easy task compared to those completing the difficult task. Similarly, for DBP, the main effect of Period was significant, $F(1, 150) = 132.09$, $p = 0.000$, $\eta_p^2 = 0.468$. DBP was higher during the stress task ($M = 71.1$ mm Hg, $SE = 0.75$), than during the rest period ($M = 65.4$ mm Hg, $SE = 0.72$). The Group X Period interaction effect, $F(1, 150) = 0.54$, $p = 0.464$, $\eta_p^2 = 0.004$, was not significant. Analysis of MAP revealed similar results; the main effect of Period was significant, $F(1, 150) = 203.0$, $p = 0.000$, $\eta_p^2 = 0.575$. MAP was higher during the stress task ($M = 86.9$ mm Hg, $SE = 0.69$), than during the rest period ($M = 80.8$ mm Hg, $SE = 0.64$). The Group X Period interaction effect, $F(1, 150) = 0.13$, $p = 0.724$, $\eta_p^2 = 0.001$, was not significant.

HR during the stress task ($M = 81.3$ bpm, $SE = 0.91$), was significantly higher than during rest ($M = 77.4$ bpm, $SE = 0.89$), $F(1, 147) = 57.07$, $p = 0.000$, $\eta_p^2 = 0.280$. The Group X

Period interaction effect was not significant, $F(1, 147) = 0.75$, $p = 0.389$, $\eta_p^2 = 0.005$. For SDNN, neither the Period, $F(1, 147) = 2.46$, $p = 0.119$, $\eta_p^2 = 0.016$, nor the Period X Group interaction effect, $F(1, 147) = 3.81$, $p = 0.053$, $\eta_p^2 = 0.025$, were significant, indicating that the stressful task did not alter SDNN. HF-HRV showed a pattern similar to blood pressure and HR measures. The main effect of Period was significant, $F(1, 147) = 8.49$, $p = 0.004$, $\eta_p^2 = 0.055$. HF-HRV was lower during the stress task (M = 1334.6 ms^2, SE = 223.18), than during the rest period (M = 2370.4 ms^2, SE = 910.49). The Group X Period interaction effect, $F(1, 147) = 0.50$, $p = 0.480$, $\eta_p^2 = 0.003$, was not significant. For LF-HRV, the Period main effect, $F(1, 147) = 4.99$, $p = 0.027$, $\eta_p^2 = 0.033$ was significant. Additionally, the Group X Period interaction effect, $F(1, 147) = 5.16$, $p = 0.025$, $\eta_p^2 = 0.034$, was significant. For those completing the difficult task, resting LF-HRV (M = 1379.8 ms^2, SE = 134.19) was higher than during the stress task, (M = 998.7 ms^2, SE = 132.05). However, for those completing the easy task, resting LF-HRV (M = 1303.1 ms^2, SE = 135.10) was not significantly different from task LF-HRV (M = 1401.1 ms^2, SE = 132.94). In sum, with the exception of SDNN, autonomic arousal occurred in response to the difficult task and for all but LF-HRV in response to the easy task.

Group (Easy, Difficult) X Minute (Task minutes 1, 3, 5) mixed factors ANOVAs were also used to examine minute-to-minute differences in cardiovascular parameters during completion of the Raven's Matrices tasks (See ANOVA Summary Tables 20-29 in Appendix B). For SBP, the main effect for Period was significant, $F(2, 300) = 41.85$, $p = 0.000$, $\eta_p^2 = 0.218$. SBP during the first minute of the stress task (M = 120.8 mm Hg, SE = 1.04) was significantly higher than SBP during minute 3, (M = 118.7 mm Hg, SE = 1.07), which was significantly higher than SBP during minute 5, (M = 115.8 mm Hg, SE = 0.94). The Group X Period interaction effect, $F(2, 300) = 1.18$, $p = 0.308$, $\eta_p^2 = 0.008$, was not significant, meaning there was no difference in patterns of SBP reactivity between those completing the easy and difficult tasks. For DBP, the main effect for Period, $F(2, 300) = 12.01$, $p = 0.000$, $\eta_p^2 = 0.074$, was significant, while the Group X Period interaction effect, $F(2, 300) = 0.905$, $p = 0.406$, $\eta_p^2 = 0.006$, was not significant. DBP during the first minute of the stress task (*M* = 73.09 mm Hg, *SE* = 0.80) was significantly higher than DBP during minute 3, (*M* = 70.24 mm Hg, *SE* = 0.88) and DBP during minute 5, (*M* = 70.04 mm Hg, *SE* = 0.87). There was no difference between DBP during minutes 3 and 5 of the task. The pattern of reactivity for MAP was similar to that of SBP; the main effect for Period, $F(2, 300) = 27.5$, $p = 0.000$, $\eta_p^2 = 0.155$, was significant, while the Group X Period interaction effect, $F(2, 300) = 1.52$, $p = 0.220$, $\eta_p^2 = 0.010$, was not significant. MAP during the first minute of the stress task (*M* = 89.0 mm Hg, *SE* = 0.72) was significantly higher than MAP during minute 3, (*M* = 86.38 mm Hg, *SE* = 0.79), which was significantly higher than MAP during minute 5, (*M* = 85.30 mm Hg, *SE* = 0.75).

For HR, both the main effect for Period, $F(2, 294) = 19.51$, $p = 0.000$, $\eta_p^2 = 0.117$, and the Group X Period interaction effect, $F(2, 294) = 4.41$, $p = 0.013$, $\eta_p^2 = 0.029$, were significant. For those completing the difficult task, HR significantly decreased from minute one, (*M* = 82.41 bpm, *SE* = 1.49), to minute three, (*M* = 81.44 bpm, *SE* = 1.33), and again decreased from minute three to minute five, (*M* = 80.49 bpm, *SE* = 1.23). However, for those completing the easy task, HR significantly decreased from minute one, (*M* = 83.40 bpm, *SE* = 1.50), to minute three, (*M* = 79.80 bpm, *SE* = 1.34), but did not decrease from minute three to minute five (*M* = 80.31 bpm, *SE* = 1.24). For those completing the difficult task, HR decreased more slowly during the task compared to those completing the easy task. Across all BP and HR parameters, the greatest reactions occurred during the first minute of the task.

For purposes of analyzing cardiovascular reactivity to the Raven's Matrices tasks to examine the primary study hypotheses, measures of BP were averaged across minutes to obtain average cardiovascular reactions for the entire task. The average of continuous HR for the entirety of the task was used for HR analyses to examine study hypotheses.

Recovery Period. Individual values for each cardiovascular parameter during the recovery period were used to calculate area under the curve (AUC) using the formula used by Whited et al. (2010), Neumann, Waldstein, Sellers, Thayer, and Sorkin (2004), and Friedberg, Suchday, and Shelov (2007). The formula used was:

Excursion = (0.5*120)*((cardiovascular measure at Task min 4) + (2* cardiovascular measure at recovery min 1) + (2*cardiovascular measure at recovery min 3) + (cardiovascular measure at recovery min 5) – (cardiovascular measure at baseline * 360).

By transforming values into this measure of area, rate of recovery can be captured in a single value for each cardiovascular measure. A larger number, or larger area under the curve, indicated a more prolonged recovery.

Consideration of Covariates. Potential covariates were assessed by calculating correlation coefficients between each potential covariate and resting and reactivity measures for each cardiovascular parameter (See Correlation Summary Tables 30-34 in Appendix B). Continuous variables assessed as potential covariates included BMI, trait anxiety, and neuroticism/negative affect. BMI was significantly related to resting SBP (r = 0.412, p = 0.000), task SBP (r = 0.350, p = 0.000), resting DBP (r = 0.261, p = 0.001), task DBP (r = 0.253, p = 0.002), resting MAP (r = 0.382, p = 0.000), and task MAP (r = 0.347, p = 0.000). BMI was therefore entered as a covariate in all BP analyses. Trait anxiety was significantly related to optimism, (r = -0.777, p = 0.000). Neuroticism/negative emotionality was also significantly correlated with optimism (r = -0.660, p = 0.000). Therefore, as the literature suggests, trait anxiety and neuroticism were used as covariates in all analyses. BMI was not related to any measure of HR, SDNN, HF-HRV, or LF-HRV. Intelligence (measured by digit-symbol task) was not related to any cardiovascular parameter,

Cardiovascular Measures at Rest

Optimism (optimist, pessimist) X Task Difficulty (Easy, Difficult) ANCOVAs were conducted for each cardiovascular parameter to determine if there were any differences during the initial rest period between groups (See ANCOVA Summary Tables 35-41 in Appendix B). Covariates included BMI, trait anxiety, and Neuroticism. There were no significant differences between groups at rest. See the first panel of Figures 1-4 and Table 2 for means, standard errors, and standard deviations for resting SBP, DBP, MAP, and HR.

Primary Analyses: Cardiovascular Reactivity to the Task

Because the primary hypotheses of this study pertain to differences between optimists and pessimists to stressors of differing difficulty, two-way Optimism (optimist, pessimist) X Task Difficulty (Easy, Difficult) ANCOVAs were conducted for each parameter, covarying resting levels, BMI (for BP analyses), trait anxiety, and negative emotionality (See ANCOVA Summary Tables 42-51 in Appendix B). See the middle panel of Figures 1-4 for means and standard errors for SBP, DBP, MAP, and HR during the Raven's Matrices task.

***Systolic Blood Pressure*.** The ANCOVA on SBP reactivity to the stress tasks revealed no significant main effects for Optimism, $F(1, 143) = 3.62$, $p = 0.059$, $\eta_p^2 = 0.025$, or Task Difficulty, $F(1, 143) = 0.623$, $p = 0.431$, $\eta_p^2 = 0.004$. The Optimism X Task Difficulty interaction effect was also not significant, $F(1, 143) = 0.329$ $p = 0.567$, $\eta_p^2 = 0.002$. It should be noted a post-hoc power analysis using the obtained effect size from the analysis of SBP reactivity to the task ($\eta_p^2 = 0.025$) revealed the obtained power of this experiment was 0.500, indicating there was a 50.0% chance statistically significant difference would be found when such a difference truly existed.

***Diastolic Blood Pressure*.** The ANCOVA on DBP reactivity to the Raven's Matrices task revealed a main effect for Optimism, $F(1, 143) = 5.82$, $p = 0.017$, $\eta_p^2 = 0.039$. Optimists exhibited greater DBP reactivity to the task (*covariate adjusted M* = 72.8 mm Hg, *SE* = 0.88) compared to pessimists (*covariate adjusted M* = 69.3 mm Hg, *SE* = 0.84). Neither the main effect for Task Difficulty, $F(1, 143) = 0.686$, $p = 0.409$., $\eta_p^2 = 0.005$, nor the Optimism X Task Difficulty interaction, $F(1,143) = 0.457$, $p = 0.500$, $\eta_p^2 = 0.003$, was significant.

***Mean Arterial Pressure*.** Analysis of MAP during the Raven's Matrices' task revealed that main effects for Optimism, $F(1, 143) = 0.989$, $p = 0.322$, $\eta_p^2 = 0.007$, Task Difficulty, $F(1, 143) = 0.092$, $p = 0.762$, $\eta_p^2 = 0.001$, and the Optimism X Task Difficulty interaction effect, $F(1, 143) = 0.662$, $p = 0.417$, $\eta_p^2 = 0.005$, were not significant.

***Heart Rate*.** The ANCOVA on HR reactivity to the tasks revealed no significant main or interaction effects. Neither the main effects for Optimism, $F(1, 140) = 0.628$, $p = 0.430$, $\eta_p^2 = 0.004$, or Task Difficulty, $F(1, 140) = 0.723$, $p = 0.396$, $\eta_p^2 = 0.005$, nor the Optimism X Task Difficulty interaction, $F(1, 140) = 0.340$, $p = 0.561$, $\eta_p^2 = 0.002$, were significant.

***High Frequency Heart Rate Variability*.** The ANCOVA on HF-HRV reactivity to the tasks revealed no significant main or interaction effects. Neither the main effects for Optimism, $F(1, 140) = 0.005$, $p = 0.945$, $\eta_p^2 = 0.000$, or Task Difficulty, $F(1, 140) = 2.095$, $p = 0.150$, $\eta_p^2 = 0.015$, nor the Optimism X Task Difficulty interaction, $F(1, 140) = 0.010$, $p = 0.922$, $\eta_p^2 = 0.000$, were significant.

Standard Deviation of Normal to Normal R-R Intervals (SDNN). The ANCOVA on SDNN reactivity to the tasks revealed the main effect for Optimism, $F(1, 140) = 0.370$, $p = 0.544$, $\eta_p^2 = 0.003$, was not significant. However, the main effect for Task Difficulty, $F(1, 140) = 4.97$, $p = 0.027$, $\eta_p^2 = 0.034$, was significant. Those completing the difficult task exhibited greater SDNN reactivity to the task (*covariate adjusted M* = 58.0 ms, *SE* = 2.83; lower SDNN indicates greater reactivity) compared to those completing the easy task (*covariate adjusted M* = 67.0 ms, *SE* = 2.83). The Optimism X Task Difficulty interaction, $F(1, 140) = 3.26$, $p = 0.073$, $\eta_p^2 = 0.023$, was not significant.

Low Frequency Heart Rate Variability. Similar to SDNN, the ANCOVA on LF-HRV reactivity to the tasks revealed neither the main effect for Optimism, $F(1, 140) = 1.09$, $p = 0.298$, $\eta_p^2 = 0.008$, nor a Optimism X Task Difficulty interaction effect, $F(1, 140) = 1.27$, $p = 0.261$, $\eta_p^2 = 0.009$. The main effect for Task Difficulty, $F(1, 140) = 8.17$, $p = 0.005$, $\eta_p^2 = 0.055$, was significant. Those completing the difficult task exhibited greater LF-HRV reactivity to the task (*covariate adjusted M* = 969.9 ms^2, *SE* = 118.07; lower LF-HRV indicates greater reactivity) compared to those completing the easy task (*covariate adjusted M* = 1427.5 ms^2, *SE* = 117.78).

Comparisons of Reactivity during the first minute of the task. Analyses indicated that SBP, DBP, MAP, and HR increased from baseline significantly during the first minute of the task, then decreased from minute one to minute three. Due to the tendency of participants to habituate to stress tasks, follow-up two-way Optimism X Task Difficulty ANCOVAs were conducted for each parameter, using just the first minute of the task as the dependent variable instead of the averaged reactivity over the course of the task (See ANCOVA Summary Tables 52-55 in Appendix B). The goal of this analysis was to capture participants when they are displaying the most reactivity to the task. Using this approach, there were no significant

Optimism or Task Difficulty main effects or Optimism X Task Difficulty interaction effects for any cardiovascular parameter.

Comparisons of Reactivity between "true pessimists" and "slight pessimists." Given samples from some previous studies were more pessimistic than the current sample, pessimists in the current sample were divided into "true pessimists," (LOT-R 12 or under; n = 28) and "slight pessimists," (LOT-R between 13 and 17; n = 50). A series of one-way ANCOVAs (covarying BMI, trait anxiety, neuroticism, and resting levels of the cardiovascular parameter) were conducted to compare reactivity levels between the two pessimistic groups (See ANCOVA Summary Tables 56-63 in Appendix B). For SBP, there was a significant effect of pessimist group, $F(1, 72) = 5.41$, $p = 0.023$, $\eta_p^2 = 0.070$. Slight pessimists (*covariate adjusted M* = 120.3 mm Hg, *SE* = 1.05) had higher reactivity compared to true pessimists (*covariate adjusted M* = 116.1 mm Hg, *SE* = 1.42). There were no differences between true and slight pessimists for any other cardiovascular parameter.

Primary Analyses: Cardiovascular Recovery from Stress

To assess whether optimists and pessimists differed in cardiovascular recovery following stress, two-way Optimism X Task Difficulty ANCOVAs were conducted on the Area under the curve (AUC) for each HR and BP parameter. Averaged reactivity during each task, trait anxiety, neuroticism, and BMI were included as covariates for each BP analysis (See ANCOVA Summary Tables 64-71 in Appendix B). BMI was not included as a covariate in any HR or HRV analyses. See the final panel of Figures 1-4 for means and standard errors for measures of SBP, DBP, MAP, and HR during the recovery period.

Systolic Blood Pressure. Analysis indicated that there were no significant main effects for either Optimism, $F(1, 143) = 0.751$, $p = 0.387$, $\eta_p^2 = 0.005$, or Task Difficulty, $F(1, 143)$ =

3.03, $p = 0.084$, $\eta_p^2 = 0.021$ on SBP AUC. Likewise, the interaction between Optimism and Task Difficulty was not significant, $F(1, 143) = 0.31$, $p = 0.580$, $\eta_p^2 = 0.002$.

Diastolic Blood Pressure. For DBP AUC, the main effects of Optimism, $F(1, 143) = 1.57$, $p = 0.214$, $\eta_p^2 = 0.011$, and Task Difficulty, $F(1, 143) = 3.74$, $p = 0.055$, $\eta_p^2 = 0.026$, were not significant. The Optimism X Task Difficulty interaction was also not significant, $F(1, 143) = 1.81$, $p = 0.180$, $\eta_p^2 = 0.013$.

Mean Arterial Pressure. The main effects for Optimism, $F(1, 143) = 0.372$, $p = 0.543$, $\eta_p^2 = 0.003$, and Task Difficulty, $F(1, 143) = 0.816$, $p = 0.368$, $\eta_p^2 = 0.006$, were not significant for MAP AUC. The Optimism X Task Difficulty interaction effect was also not significant, $F(1, 143) = 1.825$, $p = 0.179$, $\eta_p^2 = 0.013$.

Heart Rate. Analysis indicated that there were no significant main effects for either Optimism, $F(1, 142) = 0.000$, $p = 0.992$, $\eta_p^2 = 0.000$, or Task Difficulty, $F(1, 142) = 1.96$, $p = 0.164$, $\eta_p^2 = 0.014$, on HR AUC. Likewise, the interaction between Optimism and Task Difficulty was not significant, $F(1, 142) = 0.12$, $p = 0.732$, $\eta_p^2 = 0.001$.

HF-HRV. Because HRV can only be measured reliably over longer periods of time (e.g., at least five minutes), AUC was not calculated for HF-HRV, LF-HRV, or SDNN. Instead, recovery analysis used single values for the entire five-minute recovery period. For HF HRV recovery, the Optimism, $F(1, 142) = 0.23$, $p = 0.630$, $\eta_p^2 = 0.002$, and Task Difficulty, $F(1, 142) = 0.67$, $p = 0.415$, $\eta_p^2 = 0.005$, main effects were not significant. The Optimism X Task Difficulty interaction effect, $F(1, 142) = 0.078$, $p = 0.78$, $\eta_p^2 = 0.001$, was also not significant.

SDNN. For SDNN recovery, the Optimism, $F(1, 142) = 0.04$, $p = 0.841$, $\eta_p^2 = 0.000$, and Task Difficulty, $F(1, 142) = 0.73$, $p = 0.394$, $\eta_p^2 = 0.005$, main effects were not significant. The

Optimism X Task Difficulty interaction effect, $F(1, 142) = 2.20$, $p = 0.140$, $\eta_p^2 = 0.015$, was also not significant.

LF-HRV. For LF-HRV recovery, the Optimism main effect, $F(1, 142) = 1.40$, $p = 0.238$, $\eta_p^2 = 0.010$, and the Optimism X Task Difficulty interaction effect, $F(1, 142) = 0.09$, $p = 0.766$, $\eta_p^2 = 0.001$, were not significant. The main effect for Task Difficulty, $F(1, 142) = 5.84$, $p = 0.017$, $\eta_p^2 = 0.040$, however, was significant. Those completing the difficult task exhibited greater LF-HRV recovery from the task (*covariate adjusted M* = 1614.36 ms^2, *SE* = 135.26; higher LF-HRV indicates more complete recovery, because LF-HRV is high at rest, then dips during stress) compared to those completing the easy task (*covariate adjusted M* = 1330.4 ms^2, *SE* = 136.05).

Task Score

Scores on the Raven's Matrices task were analyzed in order to determine if there were performance differences between optimists and pessimists on the difficult and easy tasks. A two-way (Optimism X Task Difficulty) ANCOVA (covarying digit-symbol score) was conducted (See ANCOVA Summary Tables 72-76 in Appendix B). Results indicated that the main effect for Task Difficulty, $F(1, 147) = 808.42$, $p = 0.000$, $\eta_p^2 = 0.846$, was significant. Participants completing the difficult task solved fewer of the puzzles correctly ($M = 2.45$, $SE = 0.18$) than those completing the easy task ($M = 9.58$, $SE = 0.18$). Neither the Optimism main effect, $F(1, 147) = 0.237$, $p = 0.627$, $\eta_p^2 = 0.002$, nor the Optimism X Task Difficulty interaction effect, $F(1, 147) = 1.50$, $p = 0.229$, $\eta_p^2 = 0.010$, were significant.

Participants were divided into "true optimists" (LOT-R total score of 25-30) and "true pessimists" (LOT-R score of 12 or below) in order to determine whether a more distinctive gap between optimists and pessimists would result in task performance differences. A two-way

(True optimist/true pessimist X Task Difficulty) ANCOVA (covarying digit-symbol score) was conducted to assess task performance differences between true optimists and true pessimists. The optimist group main effect, $F(1, 62) = 2.38$, $p = 0.128$, $\eta_p^2 = 0.037$, and optimist group X task difficulty interaction effect, $F(1, 62) = 2.39$, $p = 0.127$, $\eta_p^2 = 0.037$, were both not significant. The Task Difficulty main effect, $F(1, 62) = 341.59$, $p = 0.000$, $\eta_p^2 = 0.846$, was significant. Participants completing the difficult task solved fewer of the puzzles correctly (M = 2.36, SE = 0.29) than those completing the easy task (M = 9.58, SE = 0.26).

Task performance can also be conceptualized as an indicator of task engagement. Because differences in task performance may account for the increased DBP reactivity observed among optimists in contrast to pessimists, an additional Optimism X Task Difficulty ANCOVA was conducted on DBP reactivity, covarying BMI, trait anxiety, neuroticism, resting levels, *and* task score. Results were similar to the initial analyses of DBP reactivity without adding task score as a covariate. The Optimism main effect, $F(1, 142) = 6.25$, $p = 0.014$, $\eta_p^2 = 0.042$, remained significant, while the Task Difficulty main effect, $F(1, 142) = 0.56$, $p = 0.457$, $\eta_p^2 = 0.004$, and the Optimism X Task Difficulty interaction effect, $F(1, 142) = 0.31$, $p = 0.581$, $\eta_p^2 = 0.002$, were not significant. These results suggest that task engagement did not account for the difference in DBP reactivity between optimists and pessimists.

Measures of Affect

The MAACL-R was given immediately after the completion of the recovery period. Scores on three MAACL-R subscales (Anxiety, Depression, and Hostility) were combined to obtain a single negative affect score. For means and standard deviations of positive and negative affective responses during the experiment, see Table 3. Because measures of positive and negative affect were positively skewed, all affect scores were transformed using a square root transformation to reach normality. Separate two-way ANOVAs (Optimism vs. Task Difficulty) were conducted on the measure of positive affect and negative affect (See ANOVA Summary Tables 77-82 in Appendix B).

Positive affect. The ANOVA on positive affect revealed a significant main effect for Optimism, $F(1, 148) = 35.36$, $p = 0.000$, $\eta_p^2 = 0.193$. Optimists reported more positive affect ($M = 4.03$, $SE = 0.27$) than pessimists ($M = 1.82$, $SE = 0.27$). The main effect for Task Difficulty was also significant, $F(1, 148) = 54.97$, $p = 0.000$, $\eta_p^2 = 0.271$. Those completing the easy task reported more positive affect ($M = 4.18$, $SE = 0.27$) compared to those who completed the difficult task ($M = 1.67$, $SE = 0.27$). The Optimism X Task Difficulty interaction effect, $F(1, 148) = 0.002$, $p = 0.962$, $\eta_p^2 = 0.000$, however, was not significant.

Negative affect. The ANOVA on negative affect also showed a significant main effect for Optimism, $F(1, 148) = 4.33$, $p = 0.039$, $\eta_p^2 = 0.028$. Optimists reported less negative affect ($M = 3.32$, $SE = 0.35$) than pessimists ($M = 4.21$, $SE = 0.34$). The main effect for Task Difficulty was also significant, $F(1, 148) = 22.71$, $p = 0.000$, $\eta_p^2 = 0.133$. Those completing the difficult task reported more negative affect ($M = 4.95$, $SE = 0.35$) compared to those who completed the easy task ($M = 2.58$, $SE = 0.35$). The Optimism X Task Difficulty interaction effect, $F(1, 148) = 1.57$, $p = 0.212$, $\eta_p^2 = 0.011$, however, was not significant.

Post-experimental questionnaire

To examine responses to items on the Post-Experiment Questionnaire, a series of 2 X 2 (Optimism by Task Difficulty) ANOVAs was conducted (See ANOVA Summary Tables 83-96 in Appendix B). Means and standard errors for each item of the Post-Experiment Questionnaire are shown in Table 4. For purposes of presenting these results, only significant effects will be reported here.

How stressful was the task? There was a significant Task Difficulty main effect for the item "How stressful was the task?" $F(1, 148) = 64.94$, $p = 0.000$, $\eta_p{}^2 = 0.305$. Those completing the difficult task rated the task as more stressful ($M = 3.44$, $SE = 0.10$) compared to those completing the easy task ($M = 2.33$, $SE = 0.10$).

How difficult were the problems? There was a significant Task Difficulty main effect for the item "How difficult were the problems on this task?" $F(1, 148) = 190.11$, $p = 0.000$, $\eta_p{}^2 = 0.562$. Those completing the difficult task rated the problems as more difficult ($M = 4.33$, $SE = 0.10$) compared to those completing the easy task ($M = 2.57$, $SE = 0.10$).

How much effort to complete the task? The Task Difficulty main effect was also significant for the item "How much effort did you put into completing the problems?" $F(1, 148) = 17.17$, $p = 0.000$, $\eta_p{}^2 = 0.104$. Those completing the difficult task indicated that they put more effort into completing the problems ($M = 4.18$, $SE = 0.09$) compared to those completing the easy task ($M = 3.70$, $SE = 0.09$).

Perceived performance Rating. There was also a significant Task Difficulty main effect for the item "How well do you think you performed on the task?" $F(1, 148) = 327.19$, $p = 0.000$, $\eta_p{}^2 = 0.689$. Participants completing the easy task reported performing better ($M = 3.73$, $SE = 0.09$) compared to completing the difficult task ($M = 1.53$, $SE = 0.09$). The Optimism main effect was also significant for this item, $F(1, 148) = 5.43$, $p = 0.021$, $\eta_p{}^2 = 0.035$. Optimists perceived that they performed better on the task ($M = 2.77$, $SE = 0.09$) compared to pessimists ($M = 2.49$, $SE = 0.09$).

Persistence Rating. Main effects for both Optimism, $F(1, 148) = 6.51$, $p = 0.012$, $\eta_p{}^2 = 0.042$, and Task Difficulty, $F(1, 148) = 20.54$, $p = 0.000$, $\eta_p{}^2 = 0.122$, were significant for the item "How persistent were you in completing the task?" Optimists rated themselves as more persistent in completing the task (*M* = 4.08, *SE* = 0.11) compared to pessimists (*M* = 3.71, *SE* = 0.10). Those completing the easy task rated themselves as more persistent (*M* = 4.23, *SE* = 0.10) compared to those completing the difficult task (*M* = 3.56, *SE* = 0.10).

Discontent with performance Rating. There was a significant Task Difficulty main effect for the item "How upset are you about your performance on the task?" $F(1, 148) = 30.96$, $p = 0.000$, $\eta_p{}^2 = 0.173$. Participants completing the difficult task were more upset with their performance (*M* = 2.71 *SE* = 0.12) compared to those completing the easy task (*M* = 1.76, *SE* = 0.12).

Self-efficacy Ratings.

Participants completed the self-efficacy questionnaire to assess confidence in their ability to complete the task prior to task engagement. There was little variation among participants, as nearly every participant endorsed being "somewhat confident" or "very confident" they would be able to accurately complete all of the items during the task. Regardless, an Optimism X Task Difficulty ANOVA was performed to determine if there were differences between groups in regard to self-efficacy (See ANOVA Summary Table 97-99 in Appendix B). There were no differences between optimists and pessimists, $F(1, 148) = 0.149$, $p = 0.700$, $\eta_p{}^2 = 0.001$, or between participants completing the easy versus difficult tasks, $F(1, 148) = 0.10$, $p = 0.756$, $\eta_p{}^2 = 0.001$.

Additionally, to determine whether self-efficacy and digit-symbol score predicted one's task performance score, regression analyses were conducted for those completing the difficult task and those completing the easy task separately. For those completing the difficult task, neither self-efficacy, $\beta = 0.119$, $p = 0.305$, nor digit-symbol task score, $\beta = 0.124$, $p = 0.285$, were significantly associated with task performance. However, for those completing the easy task, self-efficacy, $\beta = 0.288$, $p = 0.011$, significantly predicted task performance, such that higher self-efficacy was related to higher task performance. Digit-symbol score, $\beta = -0.191$, $p = 0.088$, did not predict task performance for those completing the easy task.

Analysis of Optimism and Pessimism Subscales.

Two previous studies examining the relation between optimism and cardiovascular reactivity to stress (Puig-Perez et al., 2015; Terrill et al., 2010) found no relation when utilizing the LOT-R total score, but found a significant relation when LOT-R optimism and pessimism subscales were analyzed separately. Therefore, additional analyses examining optimism and pessimism subscales were warranted.

Reactivity to task. Hierarchical regressions entering resting levels of the designated cardiovascular parameter, BMI (for BP analyses), trait anxiety, and neuroticism in the first step and LOT-R optimist and pessimist subscales and task difficulty in the second step, were performed to predict reactivity to the stress task for each cardiovascular parameter (See Regression Summary Tables 100-107 in Appendix B). The pessimism scale was a significant predictor of reactivity to the stress task for both DBP, $\beta = 0.177$, $p = 0.023$, and MAP, $\beta = 0.183$, $p = 0.014$. In both cases, low pessimism was associated with increased reactivity to the task. Task difficulty was not related to reactivity for either DBP or MAP.

Task Difficulty was a significant predictor for reactivity for both SDNN, $\beta = 0.128$, $p = 0.040$, and LF-HRV, $\beta = 0.171$, $p = 0.007$. Previous analyses demonstrated those completing the difficult task had greater SDNN and LF-HRV reactivity compared to those completing the easy task. This finding was confirmed in this analysis.

Recovery from task. Hierarchical regressions entering BMI (for BP analyses), trait anxiety, and neuroticism in the first step and LOT-R optimist and pessimist subscales and task difficulty in the second step, were performed to predict recovery following the stress task for each cardiovascular parameter (See Regression Summary Tables in Appendix C on Pages 108-113). For HRV analyses, task levels were entered in the first step of the regression. Neither optimism nor pessimism subscales were significant predictors of recovery for any cardiovascular parameter. Congruent with the primary analyses, Task Difficulty was a significant predictor of LF-HRV recovery: $\beta = -0.142$, $p = 0.028$. Those completing the difficult task had more complete recovery to resting levels compared to those completing the easy task.

Health behaviors and demographic differences between optimists and pessimists.

In order to assess for differences in health behaviors and perceived SES between groups, Optimism X Task Difficulty ANOVAs were conducted on the following variables: caffeine intake, alcohol intake, exercise, and perceived SES (See ANOVA Summary Tables 114-118 in Appendix B). There were no significant main or interaction effects for caffeine intake, [Optimism, $F(1, 148) = 1.48$, $p = 0.226$, $\eta_p^2 = 0.010$, Task Difficulty, $F(1, 148) = 0.05$, $p = 0.821$, $\eta_p^2 = 0.000$, Optimism X Task Difficulty interaction, $F(1, 148) = 0.000$, $p = 0.995$, $\eta_p^2 = 0.000$], alcohol intake, [Optimism, $F(1, 148) = 1.53$, $p = 0.218$, $\eta_p^2 = 0.010$, Task Difficulty, $F(1, 148) = 3.21$, $p = 0.075$, $\eta_p^2 = 0.021$, Optimism X Task Difficulty interaction, $F(1, 148) = 0.16$, $p = 0.687$, $\eta_p^2 = 0.001$], or exercise, [Optimism, $F(1, 148) = 0.53$, $p = 0.470$, $\eta_p^2 = 0.004$, Task Difficulty, $F(1, 148) = 0.01$, $p = 0.932$, $\eta_p^2 = 0.000$, Optimism X Task Difficulty interaction, $F(1, 148) = 3.30$, $p = 0.071$, $\eta_p^2 = 0.022$]. Results for SES revealed a significant main effect for Optimism, $F(1, 148) = 3.95$, $p = 0.049$, $\eta_p^2 = 0.026$. Optimists perceived themselves as having higher SES (based on a scale of one to 10, with one being lower SES and 10 being higher SES; $M = 6.01$, $SE = 0.19$), compared to pessimists ($M = 5.49$, $SE = 0.19$). Neither the main effect for Task

Difficulty, $F(1, 148) = 0.003$, $p = 0.959$, $\eta_p^2 = 0.000$, nor the Optimism X Task Difficulty interaction effect, $F(1, 148) = 0.003$, $p = 0.959$, $\eta_p^2 = 0.000$, was significant.

Chaos theory

In the current study, BP and HR was averaged across time periods for analytic purposes. Another perspective, chaos theory, is interested in individual differences in changes or fluctuations of cardiovascular parameters that occur across a time period, as opposed to averaging across a time period (Goldberger, 2000). For example, HR naturally fluctuates in a somewhat chaotic manner across time, however, when under stress, these fluctuations are reduced and HR becomes more patterned. Both HF-HRV and LF-HRV are measures that are calculated by examining the variability of waveforms across time using spectral waveform analysis, and therefore reflect values that take into account variations in time associated with chaotic activity.

In the current study, BP was measured only three times per period (rest, task, recovery), and thus chaotic fluctuations in BP occurring continuously were not able to be assessed. However, one could attempt to explore patterns of reactivity by examining changes which occurred across the task period from the perspective of chaos theory. To examine differential patterns of reactivity during the stress task, participants were classified as falling into one of five patterns: (1) sustained reactors (BP reaction stays stable across entire task), (2) habituators (BP reaction declines across the task), (3) sensitizers (BP reactions intensify over the duration of the task), (4) mixed (BP reactions increases from minute one to minute three, but then decreases from minute three to minute five), or (5) non-reactors (BP does not increase more than two mm Hg above resting levels at any point during the stress task). Because task differences in BP reactivity were not observed in this study, task difficulty was not considered in categorizing participants in this way. LOT-R scores and performance scores of participants categorized into these five patterns of reactivity were compared using one-way ANCOVA's, using trait-anxiety and neuroticism as covariates (See ANCOVA Summary Tables 119-123 in Appendix B). Patterns of SBP reactivity, $F(4, 145) = 0.726$, $p = 0.576$, $\eta_p^2 = 0.020$, and MAP reactivity, $F(4, 145) = 2.197$, $p = 0.072$, $\eta_p^2 = 0.057$, were not associated with LOT-R score. However, LOT-R score differed across patterns of DBP reactivity, $F(4, 145) = 4.01$, $p = 0.004$, $\eta_p^2 = 0.100$. Those who were categorized as non-reactors had significantly lower LOT-R scores (more pessimistic) ($M = 16.39$, $SE = 0.97$) than those categorized as either sustained reactors ($M = 20.18$, $SE = 0.744$) or sensitizers ($M = 20.64$, $SE = 0.774$). Patterns of SBP reactivity, $F(4, 145) = 1.195$, $p = 0.315$, $\eta_p^2 = 0.032$, DBP reactivity, $F(4, 145) = 0.511$, $p = 0.728$, $\eta_p^2 = 0.014$, and MAP reactivity, $F(4, 145) = 0.286$, $p = 0.887$, $\eta_p^2 = 0.008$, were not associated with task performance.

Discussion

Several previous studies have examined the relation between optimism and cardiovascular reactivity to stress; however, many of these studies had significant shortcomings. The purpose of this study was to examine the association between optimism and cardiovascular reactivity to stress by addressing several of the shortcomings of previous studies. This study also sought to test Carver and Scheier's Behavioral Self-Regulation Model, which hypothesizes that optimists, compared to pessimists, are likely to engage more (and potentially experience more autonomic arousal) when their goals are blocked by obstacles. First, it was hypothesized during a difficult task, optimists would fully engage their resources, and thus display greater autonomic reactivity compared to pessimists. This was indeed true, as optimists displayed greater DBP reactivity compared to pessimists during the difficult task. It was also hypothesized optimists would display better performance in completing the difficult task, and slower recovery following the task compared to pessimists. Neither of these hypotheses were realized, as there were no differences in task performance or recovery following the task. Finally, it was hypothesized there would be no difference in autonomic reactivity or recovery between optimists and pessimists who completed the easy task. This hypothesis was not founded, as optimists displayed greater reactivity on the easy task. There was no difference in reactivity following the easy task. These findings are congruent with the Behavioral Self-Regulation Model, as optimists appeared to put forth more effort in both tasks and displayed greater autonomic reactivity to both tasks.

Previous studies have found mixed results regarding the relation between optimism and cardiovascular reactivity to stress. Some have found that optimists have smaller reactions to stress tasks compared to pessimists (Geers et al., 2008; Puig-Perez et al., 2015; Terrill et al., 2010; Williams et al., 1990), some have found no difference between optimists and pessimists (Bonfiglio, 2005; Kennedy & Hughes, 2004; Nes et al., 2005), and some have found that optimists are actually more reactive to stress tasks than pessimists (Richman et al., 2007; Puig-Perez et al., 2017). One study (Nes et al., 2005) found optimists had slower autonomic recovery following the stress task, although few studies have measured cardiovascular measures during recovery periods.

Although the current study found no significant differences between optimists and pessimists for most of the cardiovascular parameters assessed (i.e., MAP, HR, HF-HRV, SDNN, and LF-HRV), optimists exhibited larger DBP reactions to the experimental task than pessimists, regardless of task difficulty. This may indicate that optimists displayed greater effort in completing the task than pessimists. The pattern of reactivity was similar for SBP (optimists displaying slightly greater reactivity to both tasks), however, the difference in SBP reactivity between optimists and pessimists was not significant (*p* = .059). This finding appears to support Carver and Scheier's Behavioral Self-Regulation model, which states that optimists engage/persist more in task completion in order to overcome the obstacle compared to pessimists. This finding is congruent with the findings of Richman et al. (2007) and Puig-Perez et al. (2017), who also found optimists were more reactive to stress tasks compared to pessimists. Indeed, following the completion of the stress tasks, optimists rated themselves as performing better and being more persistent on both easy and difficult versions of the task compared to pessimists' ratings of their perceived performance and persistence (despite task performance scores being similar for both groups). Together, these findings are consistent with the hypothesis that optimists engage more and display greater cardiovascular reactivity to a stress task compared to pessimists. Despite the differences between optimists and pessimists on measures of DBP reactivity and task persistence, no differences were observed on actual task performance between optimists and pessimists. This indicates that while optimists may have been more engaged with the task, it had no detectable impact on their performance. In this regard, the increased persistence and effort in completing these tasks did not have any tangible benefits for optimists.

Although significant differences were detected on how optimists and pessimists engaged with the Raven's Matrices task in this study, there were no differences in cardiovascular recovery from the task between optimism groups. This is consistent with previous studies measuring autonomic recovery among optimists and pessimists following stress tasks. Of the six studies measuring recovery following the task, four (Bonfiglio, 2005; Kennedy and Hughes, 2004; Puig-Perez, et al., 2015; Richman et al., 2007) found no relation between optimism and recovery following a stress task. Nes, Segerstrom, and Sephton (2005) found optimism was related with slower recovery from stress, and Terrill et al., (2010) found optimism was related with faster recovery from stress. The current finding lends credence to the majority of studies, which found no relation between optimism and recovery from stress.

Interestingly, optimists in the current study thought they performed better on the tasks than pessimists, but this difference was not reflected by differences in actual task scores between them. It seems optimists were overly confident regarding their performance. The definition of an optimist is someone who tends to believe he/she will perform well in the future (Carver, Scheier, Segerstrom, 2010); however, in the context of the current study, it appears that optimists may overestimate their past success or performance as well. Overestimating one's success or performance may actually be adaptive in some circumstances. One possible benefit to being overly confident in one's performance is that an optimist may tend to ruminate less regarding performances that have not gone very well. Indeed, rumination has been linked to poorer physical and psychological health (Williams et al., 2017; Zawadski, 2015). An alternative hypothesis is that optimists and pessimists interpreted the question 'How well do you think you performed on the task?' differently. For example, pessimists might interpret this question as referring to the number of problems they correctly solved (i.e., one out of 10), in which case, they would view their performance as poor. However, optimists may interpret this question in a manner friendlier to themselves (i.e., "Given I have never completed a problem like that, getting one out of 10 correct is pretty good"). Whether optimists actually believed they performed better or whether they interpreted the question differently, both scenarios would result in less rumination about their performance. To the extent that optimism reduces rumination, this may prove to be another possible mechanism through which optimism leads to better health. While optimists may react to stressors with increased autonomic arousal, they may ruminate less if they perceive their performance as acceptable (despite their actual poor performance), resulting in better overall health. Less rumination over the course of weeks, months, years, and a lifetime could lead to better health outcomes.

While optimists and pessimists did not actually differ in task performance in the current study, there were several significant task differences observed. First, those completing the difficult task rated the task as more stressful and rated the problems as more difficult compared to those completing the easy task. Additionally, those completing the difficult task reported putting more effort into completing the problems compared to those who completed the easy task and becoming more upset than those who completed the easy task. Finally, those who completed the easy task rated their task persistence and perceived performance higher than those who completed the difficult task. Of note, the increased perceived performance ratings for those completing the easy task accurately reflected their superior performance on the task in comparison to those completing the difficult task. Additionally, the type of task influenced ratings of affect obtained at the end of the study; participants completing the easy task reported much greater positive affect and lesser negative affect than those completing the difficult task. In sum, there is evidence that the experience of completing a difficult task in this study was quite different from the experience of completing an easy task.

In regard to cardiovascular differences between those completing the difficult and easy tasks, two (out of seven) parameters showed task differences. For both SDNN and LF-HRV, those completing the difficult task demonstrated greater reactivity. The task differences for SDNN and LF-HRV are what one would expect to find; greater reactivity to a more difficult stress task matches the participants' self-report ratings and affective responses to the difficult task. It is curious, then, that these differences were seen for SDNN and LF-HRV, and not for other autonomic parameters. This finding is actually consistent with some past research. For example, Solomon, Holmes, and McCaul (1980) found that there was no difference in HR reactivity between a difficult and easy stress task; however, those completing the difficult task reported more anxiety than those completing the easy task. Light and Obrist (1983) found similar results. In some cases, then, difficulty of the task may not be the most important factor when measuring cardiovascular responses to stress, at least when measuring HR and BP. In contrast to HR, that reflects the combined influences of the sympathetic and parasympathetic branches of the autonomic nervous system, measures of HRV are thought to be influenced predominantly by parasympathetic activity mediated by the vagal nerve. It is possible that task difficulty influences parasympathetic withdrawal more than sympathetic activation, and consequently, measures of BP and HR are not sensitive enough to detect these specific neural actions.

Another explanation for the lack of differences detected on measures of HR and BP in response to task difficulty, particularly with respect to comparing cardiovascular responses of optimists and pessimists, might be the failure of experimental work to examine how cardiovascular responses change over the course of the task period as optimists and pessimists encounter tasks of varying difficulty. For example, optimists may fully engage their resources early in the task period to overcome obstacles, regardless of the difficulty of the task, but as the task proceeds, optimists may continue to persist and engage full resources if the task is difficult, but decrease their effort if the task is easy, recognizing that less engagement/persistence is needed to complete the task. Some prior research supports this idea. For example, Hoffman (2001) found that for participants completing a longer duration difficult anagram task, in which the rules were constantly changing, optimism was positively related to task engagement.

However, for those completing a longer duration straightforward anagram task in which the rules remained constant, optimism was not related to task engagement. In the current study, the stress task only lasted five minutes in duration. The five-minute stress task was long enough to capture the optimists' initial full engagement in the task (thus elevated DBP reactivity to both tasks), but may have been too short of a period to capture the optimists' decreased engagement in the easy task. Had the task periods in the current study been longer, DBP responses of optimists may have habituated to the easy task, while continuing to remain engaged in the difficult task, resulting in differences in reactivity for the two tasks. During the first minute of the stress task, there was no difference in DBP reactivity observed between optimists and pessimists; therefore, the differences in DBP emerged later as the task progressed. This suggests optimists continued to engage in task completion fully, while pessimists habituated to the tasks quickly, suggesting pessimists became less engaged in both tasks more quickly than optimists. Future research will be needed employing various task durations to examine this hypothesis thoroughly.

Examination of patterns of reactivity across the task revealed interesting information about participants' persistence during task completion. Analyses examining the patterns of reactivity over the course of the stress tasks suggest that optimists may have been more persistent during the tasks. For example, those who were categorized as sustained DBP reactors or sensitizers (DBP remained elevated or increased across the duration of the task) had significantly higher LOT-R scores (more optimistic) compared to those who were non-reactors. This sustained elevation or increase of DBP from the beginning to the end of the task possibly represents continued persistence and engagement throughout the entirety of the five-minute task. This is consistent with self-report data, in which optimists rated themselves as being more persistent compared to pessimists to both tasks. These findings are consistent with the

Behavioral Self-Regulation model, in which optimists are hypothesized to engage more in pursuit of desired goals than pessimists.

Given substantial evidence suggesting optimists have better health outcomes, including cardiovascular health, compared to pessimists, it is interesting that optimists displayed increased reactivity to the stress task, especially since increased reactivity to stress tasks is generally associated with poorer cardiovascular health outcomes. There are several possible reasons why optimists have better health outcomes despite increased reactivity to stress. First, some studies have shown optimists have lower ambulatory BP over 3-day periods (Räikkönen & Matthews, 2008; Räikkönen et al., 1999). If optimists are faced with an obstacle, they engage their resources and use approach-focused coping to overcome the obstacle and overcome an obstacle more quickly than pessimists. In this case, they would experience stress for a shorter period of time because the obstacle would be overcome more quickly, resulting in lower ambulatory BP. If the stressful experience is of longer duration, such as unemployment, housing issues, or relationship issues, an optimist's increased engagement and use of approach-focused coping could result in overcoming the stressor days, weeks, or months more quickly compared to a pessimist, and in turn, lower ambulatory BP. The result of less stress and lower ambulatory BP in general would be better health, specifically cardiovascular health. Additionally, as discussed previously, optimists may tend to ruminate less about past performance and experiences compared to pessimists, which could lead to less stress overall. In sum, optimism may be related to better health due to optimists experiencing less stress generally due to using approach-focused coping, lower ambulatory BP, less rumination, and being from higher SES backgrounds compared to pessimists.

Another factor to consider in explaining why optimism has been associated with better health outcomes but was associated with greater DBP reactivity in this study is our lack of knowledge regarding the optimal level of reactivity that should accompany completion of the Raven's Matrices Task. It could be, for example, that optimists exhibited the appropriate DBP response for completing this type of cognitive task, but that pessimists displayed a less-than-optimal under-aroused DBP response. Although McEwen and Stellar (1993) identified a blunted autonomic response as a form of allostatic load, not much research has focused on this pattern of physiological responding to stress until recently (e.g., al'Absi, 2018). al'Absi has demonstrated that such blunted cardiovascular responses are equally problematic as exaggerated responses and may shed light on behavioral risk for conditions like cardiovascular disease, pain disorders, and addiction. From this perspective, pessimists may display blunted cardiovascular responses to stress that render them incapable of solving cognitive challenges like the one used in this study.

In two previous studies (Puig-Perez et al., 2015; Terrill et al., 2010), initial analysis of total LOT-R scores did not demonstrate a relation between optimism and autonomic reactivity. However, when optimism and pessimism subscales were analyzed separately, a relation between the optimism subscale and autonomic reactivity was revealed. In contrast to these prior studies, in the current study, pessimism subscale scores, but not optimism subscale scores, were associated with DBP and MAP reactivity to the task. Higher pessimism was associated with decreased reactivity on both parameters. In other words, expecting negative outcomes in the future impacted reactivity more than a lack of expectations of positive outcomes. It could be that actively expecting bad things to happen changes how one reacts to stressful situations more than simply not expecting good things to happen. However, because these findings were not consistent with findings from the prior work, future investigations will need to examine potential reasons why pessimism was associated with the stress task used in the current study more than optimism, and the opposite pattern of findings was observed in studies that used social speech tasks as a stressor. It is interesting that the optimism subscale was related to autonomic reactivity in stress tasks involving social interaction, but the pessimism subscale was related to reactivity in the current task, which involved minimal social interaction. It may be expecting (or not expecting) good things to happen drives reactivity during social interaction, but expecting (or not expecting) negative outcomes drives reactivity in tasks not involving social interaction.

While the differing relation between reactivity and optimism and pessimism subscales may represent a difference in how expecting good things to happen vs. not expecting bad things to happen influences reactivity in different circumstances, some have argued the difference between optimism and pessimism subscales is simply a difference in wording. For example, the LOT-R pessimism scale consists of all negatively-worded items while the optimism subscale consists of all positively-worded items. Therefore, the nature of the LOT-R subscales makes it difficult to interpret differences between the subscales meaningfully. Indeed, the creators of the LOT-R point out that the meaning attached to separate optimism and pessimism subscales is unclear; they attribute the two-factor structure of the LOT-R to item wording rather than meaningful item content (Scheier et al., 1994). With this understanding, it may be the relation between pessimism subscales and reactivity in the current study, and optimism subscales in previous studies with social interaction stressors, is coincidental.

As noted earlier, the screening sample in the current study apparently was more optimistic than those reported in prior studies (e.g., Bonfiglio, 2005; Kennedy & Hughes, 2004). Consequently, the cut-off values and mean scores on the LOT-R were somewhat higher in the current study than previous work. Samples of both Bonfiglio and Kennedy and Hughes consisted of undergraduate women in contrast the current study that consisted of both men and women (although predominantly women). There was no difference in optimism levels between men and women in the current study, however, so the difference between the current sample and those in previous studies does not seem to be related to sex of participants. Samples of previous studies were similar to the current sample with regard to age and undergraduate student status. It is possible that regional differences exist in optimism. Some have postulated that optimism is affected by the context of the culture from which a person comes (You, Fung, & Isaacowitz, 2009); cultures that emphasize optimism tend to produce individuals who are more optimistic. From this perspective, however, it is difficult to generate reasons why students at West Virginia University would be more optimistic than students at other institutions. In fact, because a substantial number of students who attend West Virginia University come from Appalachia, the literature does not suggest that optimism is commonly associated with this culture (Smokowski, Evans, Cotto, & Guo, 2014; Zullig & Hendryx, 2011). It is also possible that the differences in optimism levels between the current sample and previous samples reflect generational differences in optimism. Students comprising Generation Y or the Millennial Generation have been reported to express considerable optimism (De Hauw & De Vos, 2010; Salahuddin, 2010), so it is possible differences in sample characteristics in optimism are related to the predominant generation of the student sample. Regardless of the reason for this difference in sample characteristics, the current findings may not generalize to samples with lower levels of optimism. Interestingly, if the pessimist group was defined based on LOT-R cut-offs or levels reported in prior work, different between-group differences in cardiovascular reactivity to the stressor may have been observed. By adopting a lower cut-off score to define “true pessimists” in the current study (LOT-R 12 or below), lower SBP reactions were only observed in this group and not those categorized as “slight pessimists” (LOT-R between 13-17). This finding confirms that the least reactive participants were those with the lowest scores on the LOT-R, lending further support to the finding that they may have been the least engaged with the task.

Health behaviors and demographic differences between optimists and pessimists

Others have proposed that possible differences in health behaviors and other variables (e.g., socioeconomic status) between optimists and pessimists may contribute to their disparate health outcomes. The current study also considered several of these variables in assessing for differences in health behaviors that might exist between optimists and pessimists. Interestingly, our sample did not display differences between optimists and pessimists in regard to alcohol or caffeine intake, or amount of exercise. However, in our sample optimists reported to be from higher SES compared pessimists. Other studies have shown that higher SES is linked to improved health (Adler & Ostrove, 1999), so given that optimists in our sample may come from higher SES backgrounds than pessimists, SES is possibly an additional contributing factor to explaining the health differences between optimists and pessimists. However, the nature of the relation between optimism and SES requires further exploration. In our sample, participants reported their perception of where they fall on a spectrum of perceived social status; however, their actual SES, including parents’ education, occupation, and income was not assessed. Whether their perceived SES accurately reflects their actual SES is unclear. It is possible that optimistic participants tend to view their life circumstances as more favorable compared to pessimists, despite no real differences in SES. It is also possible that optimistic people are more optimistic *because* they have higher SES, and therefore have more resources and opportunities than participants with less optimism. Further, optimists may strive harder and seek out more opportunities than pessimists because they are confident that their plans will work, and therefore they move upward on the SES spectrum. Whatever the nature of the relation between optimism and SES, SES should be explored as a potential mechanism through which optimists obtain better health in future work.

Strengths and Limitations

There are several strengths of this study that lend credence to its findings. First, the majority of previous studies measuring the relation between optimism and autonomic reactivity to stress were designed to assess variables other than optimism, and optimism analyses were secondary research questions. The current study was designed specifically to assess the relation between optimism and autonomic reactivity to stress. Given the specific goal of this study, the study was powered appropriately to examine study hypotheses as well as control for several covariates known to be associated with optimism (e.g., trait anxiety, neuroticism).

Second, the current study possessed an adequate amount of internal validity, despite its quasi-experimental design. Variables such as sex, BMI, other pertinent personality variables, prescription medication use, caffeine intake, exercise, and tobacco and other drug use were all controlled either statistically or experimentally. Additionally, participants were randomly assigned to task difficulty conditions to provide some additional control over threats to experimental validity.

Third, the study employed “easy” and “difficult” stress tasks. Results clearly showed differences in task performance and perceived difficulty of the two tasks, indicating the tasks could be confirmed as “easy” and “difficult.” Effect sizes for self-report questions related to the two tasks and task performance differences were generally in the medium to large range, demonstrating a clear difference in difficulty between the tasks.

There were some limitations to this study. First, the Behavioral Self-Regulation Model stipulates optimists will engage all of their resources to overcome obstacles and obtain their goals more than pessimists. This study employed a brief, five-minute laboratory stressor, which is unlikely to be similar to stressors or obstacles faced on a day-to-day basis. The brevity of the Raven Matrices task used did not allow for a thorough examination of the pattern of reactivity among optimists and pessimists during prolonged stressors, such as preparing for a test, finding a job, dealing with relationship problems, etc. It is possible patterns of reactivity that occur during more prolonged stressors, like those encountered in daily life, would reveal a more complete picture of how optimists and pessimists react to stressors emotionally, cognitively, and physiologically.

The Raven's Matrices tasks were equal in all but difficulty, increasing internal validity of this study. However, the ecological validity of these stress tasks is limited. Day-to-day stressors optimists and pessimists encounter are highly variable, and may include stress due to unemployment, relationship problems, financial problems, or health problems. It is possible optimists and pessimists react differently to stressors that are more pertinent to their lives. Future research should examine both autonomic and behavioral reactions to real-life stressors among optimists and pessimists.

It should also be noted the Raven's Matrices Stress tasks used in this study are cognitive stress tasks. It is possible results may differ when social or physical stress tasks are employed.

Another limitation of this study was the time of the semester that optimists and pessimists were recruited. Significantly more optimists signed up to participate towards the beginning of the study, which commenced during the Fall, 2016 semester and the first month of the Spring, 2017 semester. Pessimists did not sign up for the study as readily as optimists, and thus, recruitment of these participants took longer. More than half of the pessimists participated in the second half of the Spring, 2017 semester and the Summer, 2017 term. To complete data collection, 10 pessimists participated in the study during the first month of the Fall, 2017 semester. It is possible that differences exist between volunteers who participate at the beginning of semesters and those who participate at the end of semesters. Because the majority of pessimists participated later during data collection than optimists, any differences that emerged may be influenced by this difference in participant recruitment employed in the current study. However, it is also possible that the measure of optimism used in this study was associated with other dispositional characteristics that influence participants to seek out opportunities to obtain extra credit in their courses early versus those who delay pursuit of these opportunities.

Another limitation of the study is that the sample in the current study was relatively homogenous. Participants were predominantly Caucasian and predominantly female, ranging in age from 18-25 years old. All participants were undergraduate university students. This study would need to be conducted with a more heterogeneous community sample to determine if the observed effects are generalizable to non-student populations. This would be important given that some previous studies using different samples found different results related to optimism and reactivity during a stress task (e.g., Nes et al., 2005; Puig-Perez et al., 2015).

Additionally, the unique sample of optimists and pessimists in the current study is a limitation. In the current study, both optimists and pessimists generally had higher LOT-R scores (were more optimistic) compared to previous studies. While some participants in the study would be considered true pessimists, the pessimist group contained several participants who would not have been characterized as pessimists according to criteria reported in prior work, but were considered relative pessimists in this sample because their LOT-R scores were within the bottom tertile of scores of our student sample distribution. As shown previously, slight pessimists in the current study had greater SBP reactivity compared to true pessimists. The current sample's higher optimism levels may have influenced the manner in which they reacted to the stress tasks. The current sample comprised of mostly Caucasian participants who are receiving a college education is likely different in levels of optimism and pessimism compared to the general population.

Another limitation to this study is that numerous analyses were conducted. It is possible that the few significant findings reported were due to an increased Type I error rate, given the large number of analyses that were conducted. However, the study was powered adequately to test study hypotheses and findings with smaller effect sizes make contributions to the literature in this area.

Future Directions

Few studies have been designed specifically to assess the difference in reactivity to stress between optimists and pessimists. Evidence is mounting that supports the idea that optimists have increased reactivity to stress tasks compared to pessimists. However, the majority of these studies have employed brief laboratory stressors. More studies designed to demonstrate this phenomenon in externally valid situations are necessary. For example, more studies employing ambulatory measurement methods would help shed light on how and under what circumstances optimists display exaggerated autonomic reactions to daily stressors. Such studies may distinguish between different types of stressors. For example, participants could provide information about the nature of the stressor: stressful social interactions, work-related stress (i.e., thinking about deadlines, etc.), or stress related to physical and/or emotional danger.

Additionally, future laboratory studies designed to examine the relation between optimism and stress reactivity may employ stress tasks of varying lengths. Employing tasks of varying lengths would allow researchers to determine whether optimists initially engage more, but then adjust their level of engagement depending on the demands of the task. This type of research could also examine the temporal characteristics of task performance to determine whether task engagement is sustained throughout the entire task period or wanes as the task period progresses. If the Behavioral Self-Regulation Model is accurate, one would expect the performance of optimists and pessimists to differ, particularly in response to information regarding whether the participant is succeeding of failing at the designated task.

Finally, generational differences of the linkage between optimism and autonomic response to stress are worthy of future investigations. By solely studying undergraduate students, researchers are restricting the broad generalizations needed in order to make any firm conclusions about the beneficial aspects of optimism on health outcomes.

Summary and Conclusions

Among previous studies that examined the relation between optimism and cardiovascular reactivity to stress, four studies found that optimists were less reactive to tasks compared to pessimists (Geers et al., 2008; Puig-Perez et al., 2015; Terrill et al., 2010; Williams et al., 1990), three studies found no relation (Bonfiglio, 2005; Kennedy & Hughes, 2004; Nes et al., 2005), and three studies found that in some situations optimists were more reactive to stress than pessimists (Richman et al., 2007; Puig-Perez et al., 2017). Although Nes et al. (2005) did not find an association between optimism and reactivity, they found that optimists had slower recovery than pessimists following the task. Many of these previous studies were designed to test various other hypotheses and findings examining associations between optimism and cardiovascular reactivity hypothesis reflected secondary analyses, so they often were not powered adequately or to control for important covariates to make meaningful contributions to the literature. The current study was designed specifically to test the optimism-cardiovascular reactivity relation. Unlike many of the previous studies, this current study controlled for several factors related to optimism (e.g., neuroticism, trait anxiety) and several factors that may influence cardiovascular reactivity, including caffeine/nicotine intake, prescription drugs, and BMI. The increased control of these factors in this study increases its internal validity, thus bolstering its findings in comparison with prior work in this area. This study adds credence to previous studies' findings that optimists are actually more reactive to stress compared to pessimists, at least in response to brief mental stress tasks. This study, however, failed to support the previous finding that optimists and pessimists differed in their cardiovascular recovery following stress tasks during recovery periods (Nes, Segerstrom, & Sephton, 2005).

It is also important to acknowledge prior studies that found optimists have lower ambulatory BP compared to pessimists, but had similar BP reactivity to pessimists during acute stressors (Räikkönen & Matthews, 2008; Räikkönen et al., 1999). Combined with the findings of the current study, it seems that during periods of acute stress, optimists' BP appears to be equally or more reactive than pessimists' BP. However, over the course of entire days, weeks, and months, optimists may have lower average BP than pessimists, and in the end, the prolonged positive physiological and emotional aspects of optimism are likely to make more substantial contributions to better health than how optimists and pessimists respond to brief, acute environmental stressors.

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Table 1. *Demographics*

	Optimist (n = 74)		Pessimist (n = 78)	
	Mean(SD)	Count(%)	Mean(SD)	Count(%)
Women		64(85%)		66(84.6%)
Men		10(15%)		12(15.4%)
Age	19.4 (1.5)		19.2(1.5)	
Race				
White		61(82.4%)		63(80.8%)
Black		5(6.8%)		3(3.8%)
Asian		3(4.1%)		5(6.4%)
Native American		1(1.4%)		0
Mixed		2(2.8%)		5(6.4%
Other		1(1.4%)		0
Undisclosed		1(2.8%)		2(2.6%)
LOT-R total	25.0(2.3)[a]		13.3(2.6)[a]	
Perceived SES	6.0(1.5)[a]		5.5(1.7)[a]	
BMI	25.6 (5.6)		25.3(4.8)	
Resting SBP (mm Hg)	111.7(11.6)		111.3(9.8)	
Resting DBP (mm Hg)	65.4(8.6)		65.5(9.1)	
Resting MAP (mm Hg)	80.8(8.2)		80.7(7.6)	
Resting HR	78.0(11.0)		77.0(10.6)	
Resting SDNN	67.0(27.3)		64.2(28.8)	
Trait Anxiety	36.1(8.8)[a]		53.5(7.5)[a]	
Neuroticism	30.8(9.1)[a]		43.5(7.6)[a]	
Agreeableness	48.6(6.7)[a]		42.4(7.8)[a]	
Open Mindedness	46.3(7.7)[a]		42.1(7.2)[a]	
Conscientiousness	46.4(9.0)[a]		40.7(8.6)[a]	
Extraversion	42.9(8.9)[a]		34.7(8.8)[a]	

Note: [a] indicates a significant difference between optimists and pessimists.

Table 2. Means and standard deviations for cardiovascular parameters during rest, Task, and recovery

	Optimist			Pessimist		
	Difficult Task (n = 37)	Easy Task (n = 37)	All Optimist (n = 74)	Difficult Task (n = 39)	Easy Task (n = 39)	All Pessimist (n = 78)
SBP Rest (mm Hg)	112.6	110.7	111.7	111.6	111	111.3
	(10.3)	(12.8)	(11.6)	(9.8)	(9.9)	(9.8)
SBP Task	118.5	117.7	118.1	119.1	118.5	118.8
	(11.1)	(12.7)	(11.8)	(12.5)	(11.6)	(12.0)
SBP Recovery	111.8	112.2	112.0	111.9	112.0	112.0
	(9.8)	(12.8)	(11.3)	(11.2)	(10.2)	(10.7)
DBP Rest (mm Hg)	66.4	64.3	65.4	64.6	66.4	65.5
	(7.6)	(9.4)	(8.6)	(9.9)	(8.2)	(9.1)
DBP Task	73.1	70.8	72.0[a]	70.1	70.6	70.3[a]
	(8.4)	(10.0)	(9.3)	(9.0)	(9.4)	(9.2)
DBP Recovery	68	65.2	66.6	67.5	66.2	66.8
	(8.7)	(8.6)	(8.7)	(11.3)	(8.2)	(9.8)
MAP Rest (mm Hg)	81.8	79.8	80.8	80.2	81.2	80.7
	(6.7)	(9.5)	(8.2)	(8.4)	(6.8)	(7.6)
MAP Task	88.2	86.5	87.3	86.4	86.5	86.5
	(7.8)	(9.8)	(8.8)	(8.5)	(8.1)	(8.3)
MAP Recovery	82.6	80.9	81.7	82.3	81.5	81.9
	(7.2)	(8.3)	(7.8)	(9.9)	(6.7)	(8.4)
HR Rest (bpm)	78.8	77.1	78.0	77.7	76.3	77.0
	(10.3)	(11.8)	(11.0)	(9.8)	(11.5)	(10.6)
HR Task	81.9	81.7	81.8	81.4	80.1	80.9
	(9.7)	(11.6)	(10.6)	(10.7)	(12.6)	(11.6)
HR Recovery	80.0	78.7	79.3	78.2	77.9	78.0
	(9.8)	(11.3)	(10.5)	(9.3)	(11.2)	(10.2)
HF-HRV Rest (log(ms^2))	4716	1778	3247	1317	1675	1496
	(22058)	(2026)	(15626)	(1862)	(2010)	(1933)
HF-HRV Task	842	1307	1074	1652	1526	1590
	(850)	(1529)	(1251)	(4553)	(2360)	(3617)
HF-HRV Recovery	1016	1430	1223	1348	1419	1383
	(882)	(1562)	(1277)	(2369)	(2045)	(2199)
LF-HRV Rest (log(ms^2))	1451	1444	1448	1310	1163	1237
	(1440)	(1119)	(1281)	(1227)	(758)	(1016)
LF-HRV Task	941	1204	1072	1055	1598	1323
	(680)	(939)	(825)	(1017)	(1687)	(1406)
LF-HRV Recovery	1511[b]	1549[b]	1530	1546[b]	1264[b]	1405

	(1053)	(1401)	(1231)	(1588)	(868)	(1279)
SDNN Rest (ms)	64.1	69.9	67.0	64.5	63.9	64.2
	(24.9)	(29.5)	(27.0)	(32.3)	(25.2)	(28.8)
SDNN Task	60.0	64.3	62	54.7	71.4	62.9
	(21.5)	(24.0)	(22.8)	(26.6)	(49.5)	(40.2)
SDNN Recovery	64.9[b]	69.7[b]	67.3	64.6[b]	63.6[b]	64.1
	(23.1)	(26.2)	(24.7)	(30.9)	(23.5)	(27.3)

Note: [a] indicates a significant difference between optimists and pessimists at the p < .05 level; [b] indicates a significant difference between difficult and easy tasks at the p < .05 level; Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP), Heart Rate (HR), High-Frequency Heart Rate Variability (HF-HRV), Low Frequency Heart Rate Variability (LF-HRV), Standard Deviation of N-N Intervals (SDNN)

Table 3. *Means and standard errors for responses to the post-experimental questionnaire*

	Optimist (n = 74)		Pessimist (n = 78)	
	Difficult task (n = 37)	Easy task (n = 37)	Difficult task (n = 39)	Easy task (n = 39)
How stressful was the task?	3.3(.15)	2.4(.13)	3.6(.15)	2.3(.12)
How difficult were the problems on this task?	4.2(.14)	2.6(.15)	4.5(.09)	2.5(.13)
How much effort did you put into completing the problems?	4.2(.10)	3.4(.15)	4.2(.10)	3.6(.15)
How well do you think you performed on the task?	1.6(.14)	3.9(.12)	1.4(.09	3.6(.14)
How persistent were you in completing the task?	3.8(.16)	4.4(.10)	3.3(.19)	4.1(.11)
How upset are you by your performance on the task?	2.5(.19)	1.7(.14)	2.9(.18)	1.8(.16)

Figure 1: SBP of optimist easy (OE), optimist difficult (OD), pessimist easy (PE), and pessimist difficult (PD) during rest, task period, and recovery.

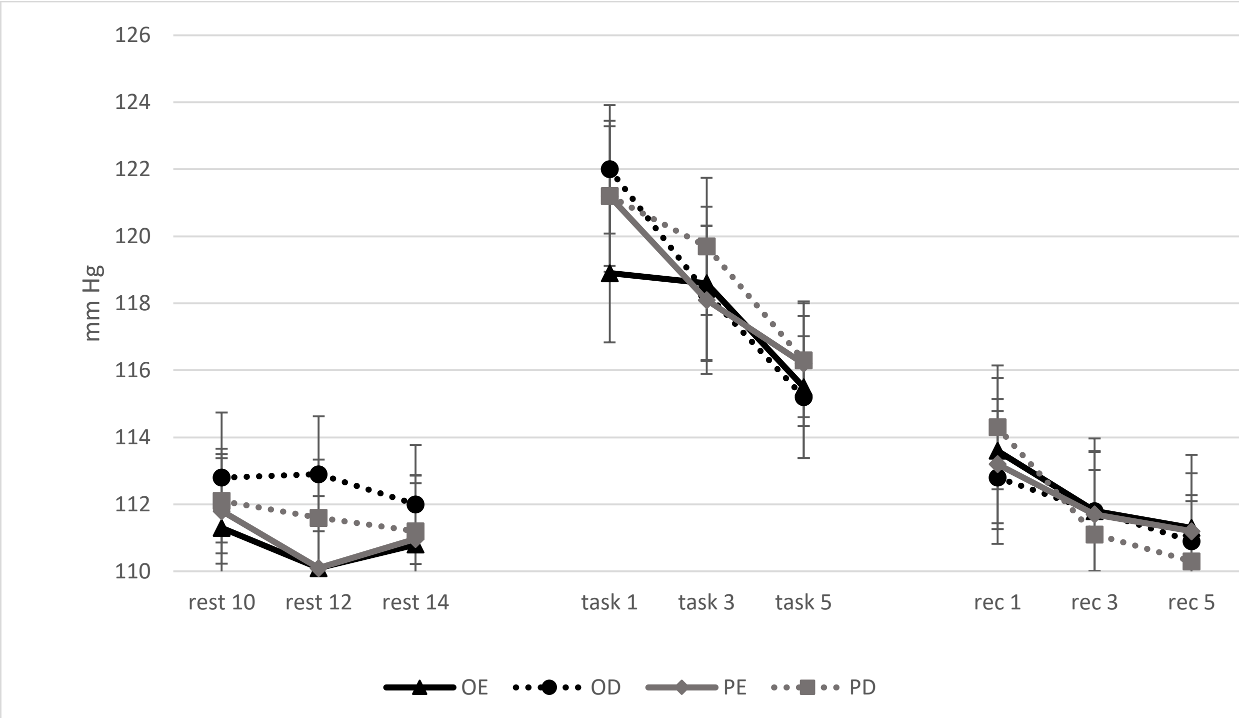


Figure 2: DBP of optimist easy (OE), optimist difficult (OD), pessimist easy (PE), and pessimist difficult (PD) during rest, task period, and recovery.

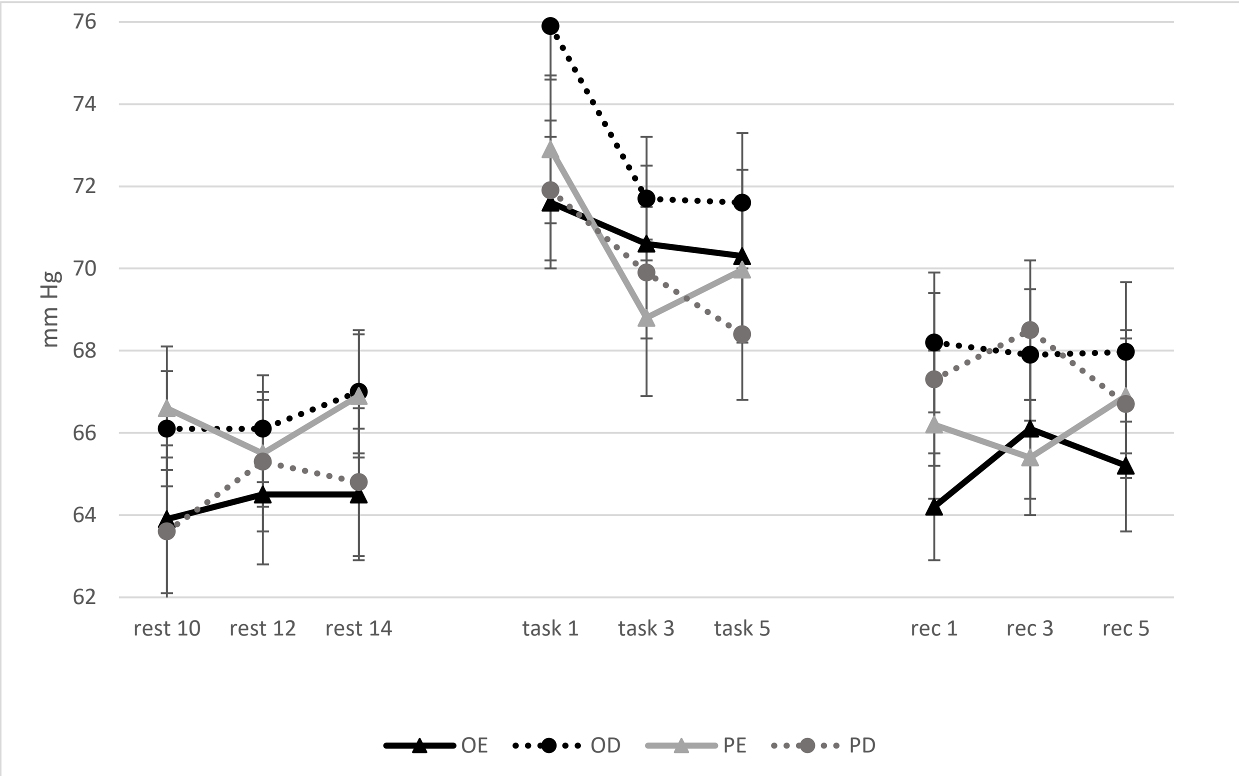


Figure 3: MAP of optimist easy (OE), optimist difficult (OD), pessimist easy (PE), and pessimist difficult (PD) during rest, task period, and recovery.

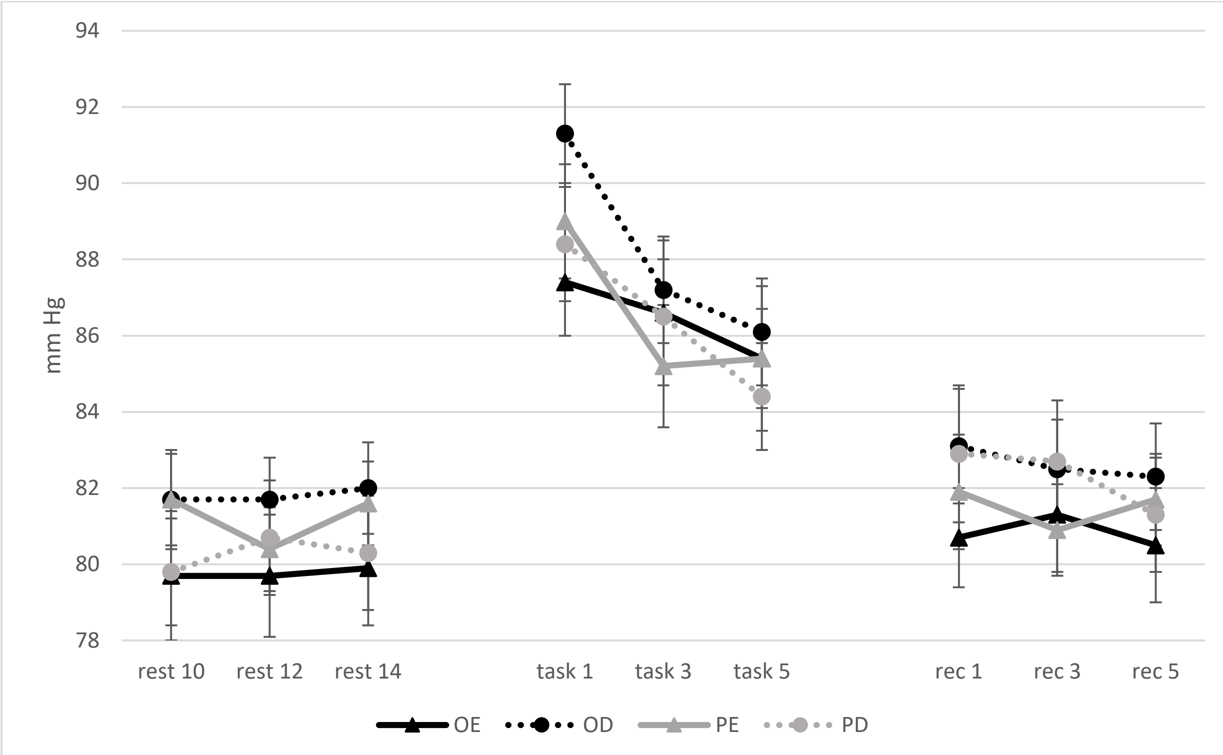


Figure 4: HR of optimist easy (OE), optimist difficult (OD), pessimist easy (PE), and pessimist difficult (PD) during rest, task period, and recovery.

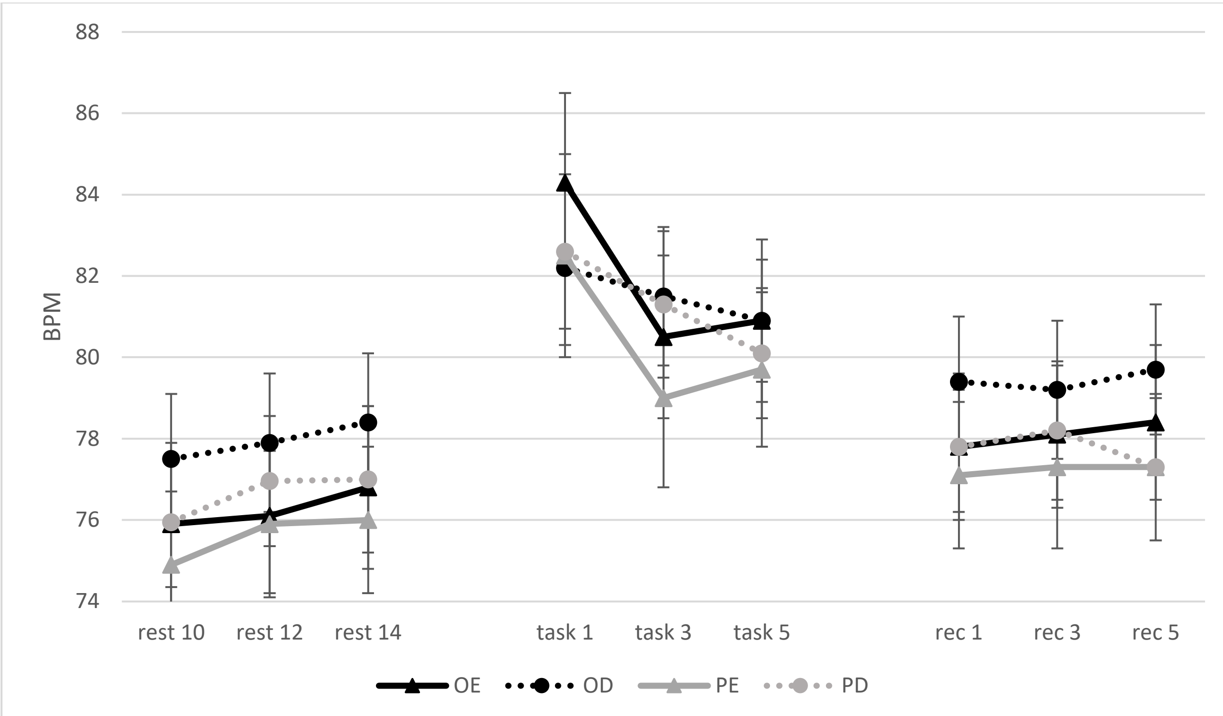


Figure 5: HF-HRV of optimist easy (OE), optimist difficult (OD), pessimist easy (PE), and pessimist difficult (PD) during rest, task period, and recovery.

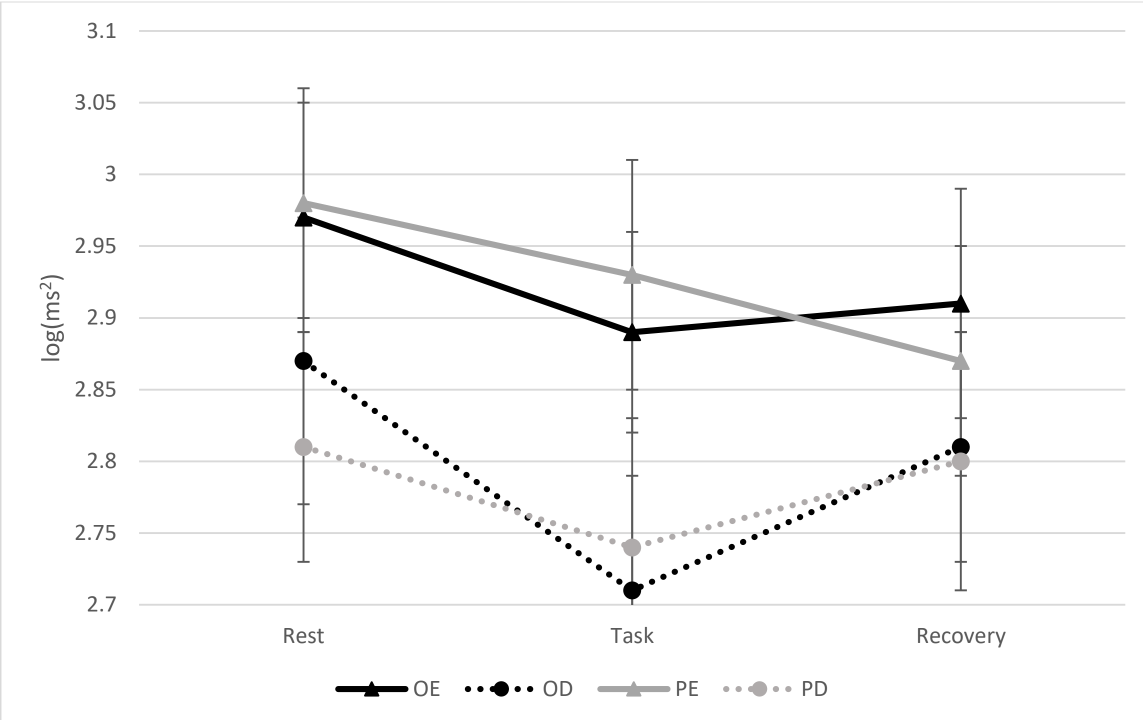


Figure 6: SDNN of optimist easy (OE), optimist difficult (OD), pessimist easy (PE), and pessimist difficult (PD) during rest, task period, and recovery.

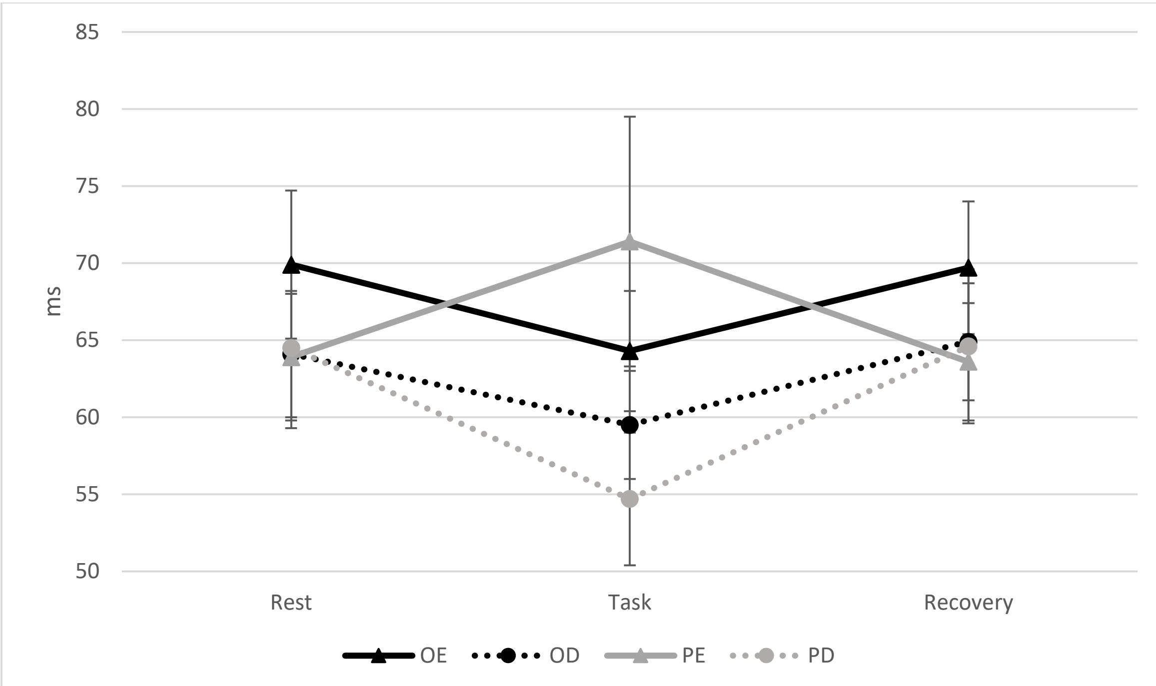
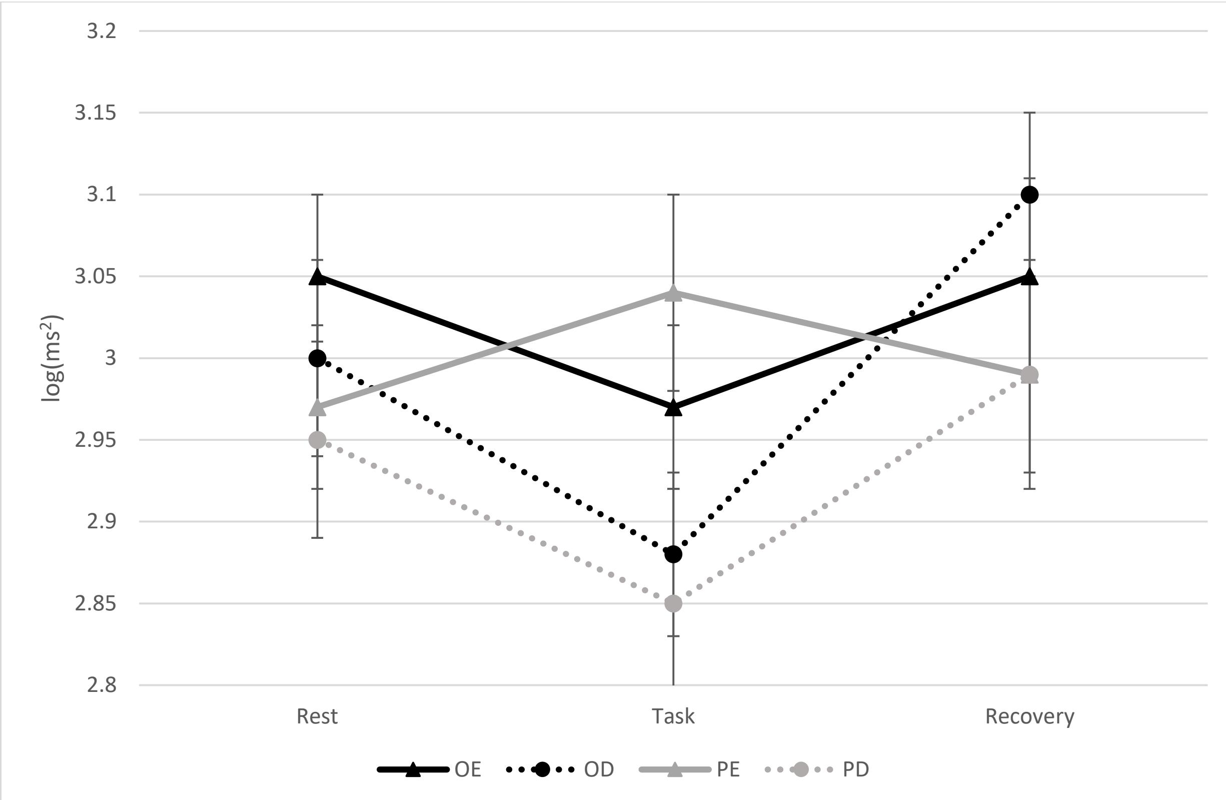


Figure 7: LF-HRV of optimist easy (OE), optimist difficult (OD), pessimist easy (PE), and pessimist difficult (PD) during rest, task period, and recovery.



Appendix A

Attachments

1. Demographics Questionnaire
2. Self-Efficacy Questionnaire
3. Post-task Questionnaire

Demographics Questionnaire

Participant #:________________________ Date:_________________________

Height(in.):_________ Weight(lbs):_________

Please provide your email address so that we can contact you for part 2 of the study:_________________________

Your Information:

Your age _____

Your sex

○ Male

○ Female

Are you Hispanic, Latino, or of Spanish origin?

○ No, not of Hispanic, Latino, or Spanish origin

○ Yes, Mexican, Mexican Am., Chicano

○ Yes, Puerto Rican

○ Yes, Cuban

○ Yes, another Hispanic, Latino, or Spanish origin (please indicate) ____________

Your race- check all that apply

○ White

○ Black, African Am., or Negro

○ American Indian or Alaska Native

○ Asian Indian

○ Chinese

○ Filipino

- Japanese
- Korean
- Vietnamese
- Native Hawaiian
- Guamanian or Chamorro
- Samoan
- Other Pacific Islander (please indicate)_______________
- Other Asian (please indicate) ________________
- Other race (please indicate) ________________

Indicate the highest level of education you have completed:

- High school
- 1 year college
- 2 years college
- 3 years college
- 4 or more years college

Please describe any cardiovascular related illness that you may have, including high blood pressure

Please list any other medical or psychiatric problems that you have:

Please list any major surgeries and medical, or psychiatric illnesses you have had *in the past*.

Females: Are you currently pregnant?

- Yes
- No

Females: Are you currently on birth control (contraceptives).

○ Yes

○ No

What type of birth control are you taking? ________________________

Please list any drugs (legal or otherwise) that you are currently taking including; birth control (contraceptives), heart medications, cold or allergy medications, over the counter medications, asthma medications, Beta-Blockers (i.e. Inderal, Tenormin), psychoactive drugs (i.e. Adderall, Xanax, Haldol, Lithium, Prozac), or diet pills.

Do you currently smoke cigarettes (within the last month)?

○ Yes

○ No

Do you currently use smokeless tobacco (within the past month)?

○ Yes

○ No

How often do you drink alcohol?

○ never

○ infrequently (a few drinks per year)

○ occasionally (1-2 drinks per month)

○ weekly (1-3 drinks per week)

○ weekly (3-6 drinks per week)

○ daily (7-14 drinks per week)

○ daily (more than 14 drinks per week)

How many cups of **caffeinated** coffee, tea, or soda do you have per day?

○ none

○ 1-2 cups per day

○ 3-4 cups per day

○ 5-6 cups per day

○ 7-8 cups per day

○ greater than eight cups per day

How many times per week do you engage in aerobic physical activity?

○ never

○ 1-2 times

○ 3-6 times

○ 7 or more times

For how long do you typically exercise on each occasion?

○ 5-10 minutes

○ 10-15 minutes

○ 15-30 minutes

○ 30-60 minutes

○ more than 60 minutes

Family Information:

Imagine a ladder that represents where people stand in the United States.

At the **top** of the ladder are the people who are the best off – those who have the most money, the most education, and the most respected jobs. At the **bottom** are the people who are the worst off – who have the least money, least education, and the least respected jobs or no job. The higher up you are on this ladder, the closer you are to the people at the very top; the lower you are, the closer you are to the people at the very bottom.

On which rung of the ladder (1 being the lowest rung and 10 being the highest rung) would you place your family?

1……….2……….3……….4……….5……….6……….7……….8……….9……….10

Is your father currently living?

○ yes

○ no

Approximately how old is your father? _________

Did/does your father have high blood pressure (hypertension)?

○ yes

○ no

How certain are you that he did, or did not, have high blood pressure (hypertension)?

○ Absolutely (100%) certain

○ Almost (75%) certain

○ Not sure at all (25%)

○ No information by which to judge (0%)

Did/does your father have any heart problems such as angina (chest pains), a heart attack, or coronary heart disease?

○ yes

○ no

If yes, please specify if you are able: ____.

How certain are you that he did, or did not, have a heart problem as indicated above?

○ Absolutely (100%) certain

○ Almost (75%) certain

○ Not sure at all (25%)

○ No information by which to judge (0%)

Is your mother currently living?

○ yes

○ no

Approximately how old is your mother? _________

Did/does your mother have high blood pressure (hypertension)?

○ yes

○ no

How certain are you that she did, or did not, have high blood pressure (hypertension)?

○ Absolutely (100%) certain

○ Almost (75%) certain

○ Not sure at all (25%)

○ No information by which to judge (0%)

Did/does your mother have any heart problems such as angina (chest pains), a heart attack, or coronary heart disease?

○ yes

○ no

If yes, please specify if you are able: ____.

How certain are you that she did, or did not, have a heart problem as indicated above?

○ Absolutely (100%) certain

○ Almost (75%) certain

○ Not sure at all (25%)

○ No information by which to judge (0%)

Self-Efficacy Questionnaire

Below is a pattern with a piece missing. Look at the pattern. Think about what shape will complete the pattern correctly both across and down. You must choose which of the pieces below is the best one to complete the pattern.

Image of Raven's Matrice puzzle placed here.

How confident are you that you will be able to accurately complete all of the items during the task?

Not at all	Somewhat unconfident	Somewhat confident	Very confident
1	2	3	4

Post Task Questionnaire

Instructions:

Please select the response below each question that best represents your answer to the question.

1. How stressful was the task?

   Not at all | Minimally stressful | Neutral | Fairly stressful | Extremely stressful

2. How difficult were the problems on this task?

   Not at all | Minimally difficult | Neutral | Fairly difficult | Extremely difficult

3. How much effort did you put into completing the problems?

   None | Minimal effort | Neutral | Fair amount of effort | A lot of effort

4. How well do you think you performed on the task?

   Extremely poorly | Somewhat poorly | Unsure | Somewhat well | Extremely well

5. How persistent were you in completing the task?

   Not at all | Minimally persistent | Neutral | Fairly persistent | Very persistent

6. How upset are you by your performance on the task?

   Not at all | Somewhat upset | Neutral | Fairly upset | Extremely upset

Appendix B: Statistical Tables

Rest Period - Repeated Measures ANOVAs across Minute (Min 1, 3, and 5)

1. SBP

Tests of Within-Subjects Effects

Measure: rest

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
SBPrest	Sphericity Assumed	65.837	2	32.918	1.922	.148	.013
	Greenhouse-Geisser	65.837	1.945	33.855	1.922	.149	.013
	Huynh-Feldt	65.837	1.970	33.425	1.922	.149	.013
	Lower-bound	65.837	1.000	65.837	1.922	.168	.013
Error(SBPrest)	Sphericity Assumed	5171.997	302	17.126			
	Greenhouse-Geisser	5171.997	293.644	17.613			
	Huynh-Feldt	5171.997	297.419	17.390			
	Lower-bound	5171.997	151.000	34.252			

2. DBP

Tests of Within-Subjects Effects

Measure: rest

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
DBP	Sphericity Assumed	43.543	2	21.771	.835	.435	.006
	Greenhouse-Geisser	43.543	1.991	21.871	.835	.434	.006
	Huynh-Feldt	43.543	2.000	21.771	.835	.435	.006
	Lower-bound	43.543	1.000	43.543	.835	.362	.006
Error(DBP)	Sphericity Assumed	7873.291	302	26.070			
	Greenhouse-Geisser	7873.291	300.619	26.190			
	Huynh-Feldt	7873.291	302.000	26.070			
	Lower-bound	7873.291	151.000	52.141			

3. MAP

Tests of Within-Subjects Effects

Measure: rest

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
MAP	Sphericity Assumed	8.678	2	4.339	.315	.730	.002
	Greenhouse-Geisser	8.678	1.993	4.354	.315	.729	.002
	Huynh-Feldt	8.678	2.000	4.339	.315	.730	.002
	Lower-bound	8.678	1.000	8.678	.315	.576	.002
Error(MAP)	Sphericity Assumed	4163.156	302	13.785			
	Greenhouse-Geisser	4163.156	300.922	13.835			
	Huynh-Feldt	4163.156	302.000	13.785			
	Lower-bound	4163.156	151.000	27.571			

4. HR

Tests of Within-Subjects Effects

Measure: rest

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
HR	Sphericity Assumed	79.701	2	39.850	6.080	.003	.039
	Greenhouse-Geisser	79.701	1.987	40.114	6.080	.003	.039
	Huynh-Feldt	79.701	2.000	39.850	6.080	.003	.039
	Lower-bound	79.701	1.000	79.701	6.080	.015	.039
Error(HR)	Sphericity Assumed	1953.273	298	6.555			
	Greenhouse-Geisser	1953.273	296.043	6.598			
	Huynh-Feldt	1953.273	298.000	6.555			
	Lower-bound	1953.273	149.000	13.109			

5.

Pairwise Comparisons

Measure: rest

(I) HR	(J) HR	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	-.676	.307	.088	-1.420	.068
	3	-1.012*	.291	.002	-1.717	-.307
2	1	.676	.307	.088	-.068	1.420
	3	-.336	.288	.736	-1.033	.361
3	1	1.012*	.291	.002	.307	1.717
	2	.336	.288	.736	-.361	1.033

6.

Estimates

Measure: rest

HR	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
1	76.053	.870	74.334	77.771
2	76.729	.879	74.992	78.466
3	77.065	.896	75.295	78.835

Task Period Reactivity - Group (Easy, Difficult) X Period (Rest, Task) ANOVAs

7. SBP

Tests of Within-Subjects Effects

Measure: SBP

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Period	Sphericity Assumed	3690.244	1	3690.244	149.180	.000	.499
	Greenhouse-Geisser	3690.244	1.000	3690.244	149.180	.000	.499
	Huynh-Feldt	3690.244	1.000	3690.244	149.180	.000	.499
	Lower-bound	3690.244	1.000	3690.244	149.180	.000	.499
Period * Task Difficulty	Sphericity Assumed	5.665	1	5.665	.229	.633	.002
	Greenhouse-Geisser	5.665	1.000	5.665	.229	.633	.002
	Huynh-Feldt	5.665	1.000	5.665	.229	.633	.002
	Lower-bound	5.665	1.000	5.665	.229	.633	.002
Error(time)	Sphericity Assumed	3710.522	150	24.737			
	Greenhouse-Geisser	3710.522	150.000	24.737			
	Huynh-Feldt	3710.522	150.000	24.737			
	Lower-bound	3710.522	150.000	24.737			

8.

Estimates

Measure: SBP

time	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	111.468	.867	109.756	113.181
2	118.436	.966	116.528	120.345

9. DBP

Tests of Within-Subjects Effects

Measure: DBP

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
period	Sphericity Assumed	2479.320	1	2479.320	132.092	.000	.468
	Greenhouse-Geisser	2479.320	1.000	2479.320	132.092	.000	.468
	Huynh-Feldt	2479.320	1.000	2479.320	132.092	.000	.468
	Lower-bound	2479.320	1.000	2479.320	132.092	.000	.468
period * TASK_difficult_easy	Sphericity Assumed	10.132	1	10.132	.540	.464	.004
	Greenhouse-Geisser	10.132	1.000	10.132	.540	.464	.004
	Huynh-Feldt	10.132	1.000	10.132	.540	.464	.004
	Lower-bound	10.132	1.000	10.132	.540	.464	.004
Error(time)	Sphericity Assumed	2815.450	150	18.770			
	Greenhouse-Geisser	2815.450	150.000	18.770			
	Huynh-Feldt	2815.450	150.000	18.770			
	Lower-bound	2815.450	150.000	18.770			

10.

Estimates

Measure: DBP

time	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	65.411	.716	63.997	66.825
2	71.123	.749	69.644	72.602

11. MAP

Tests of Within-Subjects Effects

Measure: MAP

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
period	Sphericity Assumed	2856.294	1	2856.294	203.019	.000	.575
	Greenhouse-Geisser	2856.294	1.000	2856.294	203.019	.000	.575
	Huynh-Feldt	2856.294	1.000	2856.294	203.019	.000	.575
	Lower-bound	2856.294	1.000	2856.294	203.019	.000	.575
period * TASK_difficult_easy	Sphericity Assumed	1.765	1	1.765	.125	.724	.001
	Greenhouse-Geisser	1.765	1.000	1.765	.125	.724	.001
	Huynh-Feldt	1.765	1.000	1.765	.125	.724	.001
	Lower-bound	1.765	1.000	1.765	.125	.724	.001
Error(time)	Sphericity Assumed	2110.365	150	14.069			
	Greenhouse-Geisser	2110.365	150.000	14.069			
	Huynh-Feldt	2110.365	150.000	14.069			
	Lower-bound	2110.365	150.000	14.069			

12.

Estimates

Measure: MAP

			95% Confidence Interval	
Time	Mean	Std. Error	Lower Bound	Upper Bound
1	80.764	.641	79.497	82.030
2	86.894	.693	85.525	88.263

13. HR

Tests of Within-Subjects Effects

Measure: HR

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Period	Sphericity Assumed	1117.173	1	1117.173	57.068	.000	.280
	Greenhouse-Geisser	1117.173	1.000	1117.173	57.068	.000	.280
	Huynh-Feldt	1117.173	1.000	1117.173	57.068	.000	.280
	Lower-bound	1117.173	1.000	1117.173	57.068	.000	.280
period * TASK_difficult_easy	Sphericity Assumed	14.631	1	14.631	.747	.389	.005
	Greenhouse-Geisser	14.631	1.000	14.631	.747	.389	.005
	Huynh-Feldt	14.631	1.000	14.631	.747	.389	.005
	Lower-bound	14.631	1.000	14.631	.747	.389	.005
Error(time)	Sphericity Assumed	2877.717	147	19.576			
	Greenhouse-Geisser	2877.717	147.000	19.576			
	Huynh-Feldt	2877.717	147.000	19.576			
	Lower-bound	2877.717	147.000	19.576			

14.

Estimates

Measure: HR

Time	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	77.428	.886	75.676	79.180
2	81.301	.912	79.499	83.102

15. SDNN

Tests of Within-Subjects Effects

Measure: SDNN

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
period	Sphericity Assumed	766.708	1	766.708	2.457	.119	.016
	Greenhouse-Geisser	766.708	1.000	766.708	2.457	.119	.016
	Huynh-Feldt	766.708	1.000	766.708	2.457	.119	.016
	Lower-bound	766.708	1.000	766.708	2.457	.119	.016
period * TASK_difficult_easy	Sphericity Assumed	1188.716	1	1188.716	3.810	.053	.025
	Greenhouse-Geisser	1188.716	1.000	1188.716	3.810	.053	.025
	Huynh-Feldt	1188.716	1.000	1188.716	3.810	.053	.025
	Lower-bound	1188.716	1.000	1188.716	3.810	.053	.025
Error(time)	Sphericity Assumed	45867.503	147	312.024			
	Greenhouse-Geisser	45867.503	147.000	312.024			
	Huynh-Feldt	45867.503	147.000	312.024			
	Lower-bound	45867.503	147.000	312.024			

16. HF-HRV

Tests of Within-Subjects Effects

Measure: HF

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
period	Sphericity Assumed	.708	1	.708	8.488	.004	.055
	Greenhouse-Geisser	.708	1.000	.708	8.488	.004	.055
	Huynh-Feldt	.708	1.000	.708	8.488	.004	.055
	Lower-bound	.708	1.000	.708	8.488	.004	.055
period * TASK_difficult_easy	Sphericity Assumed	.042	1	.042	.501	.480	.003
	Greenhouse-Geisser	.042	1.000	.042	.501	.480	.003
	Huynh-Feldt	.042	1.000	.042	.501	.480	.003
	Lower-bound	.042	1.000	.042	.501	.480	.003
Error(time)	Sphericity Assumed	12.268	147	.083			
	Greenhouse-Geisser	12.268	147.000	.083			
	Huynh-Feldt	12.268	147.000	.083			
	Lower-bound	12.268	147.000	.083			

17.

Estimates

Measure: HF

time	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
1	2370.357	910.486	571.025	4169.689
2	1334.617	223.182	893.558	1775.676

18. LF-HRV

Tests of Within-Subjects Effects

Measure: LF

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
period	Sphericity Assumed	.221	1	.221	4.989	.027	.033
	Greenhouse-Geisser	.221	1.000	.221	4.989	.027	.033
	Huynh-Feldt	.221	1.000	.221	4.989	.027	.033
	Lower-bound	.221	1.000	.221	4.989	.027	.033
period * TASK_difficult_easy	Sphericity Assumed	.228	1	.228	5.158	.025	.034
	Greenhouse-Geisser	.228	1.000	.228	5.158	.025	.034
	Huynh-Feldt	.228	1.000	.228	5.158	.025	.034
	Lower-bound	.228	1.000	.228	5.158	.025	.034
Error(time)	Sphericity Assumed	6.498	147	.044			
	Greenhouse-Geisser	6.498	147.000	.044			
	Huynh-Feldt	6.498	147.000	.044			
	Lower-bound	6.498	147.000	.044			

19.

4. TASK_difficult_easy * time

Measure: LF

TASK_difficult_easy	time	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1.00	1	1379.787	134.187	1114.602	1644.971
	2	998.693	132.049	737.733	1259.654
2.00	1	1303.108	135.090	1036.138	1570.078
	2	1401.122	132.939	1138.404	1663.839

Group X Period Mixed factors ANOVAs for task period

20. SBP

Tests of Within-Subjects Effects

Measure: task

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
SBP	Sphericity Assumed	1924.041	2	962.020	41.848	.000	.218
	Greenhouse-Geisser	1924.041	1.939	992.209	41.848	.000	.218
	Huynh-Feldt	1924.041	1.977	973.099	41.848	.000	.218
	Lower-bound	1924.041	1.000	1924.041	41.848	.000	.218
SBP * TASK_difficult_easy	Sphericity Assumed	54.378	2	27.189	1.183	.308	.008
	Greenhouse-Geisser	54.378	1.939	28.042	1.183	.307	.008
	Huynh-Feldt	54.378	1.977	27.502	1.183	.308	.008
	Lower-bound	54.378	1.000	54.378	1.183	.279	.008
Error(SBP)	Sphericity Assumed	6896.581	300	22.989			
	Greenhouse-Geisser	6896.581	290.872	23.710			
	Huynh-Feldt	6896.581	296.585	23.253			
	Lower-bound	6896.581	150.000	45.977			

21.

Pairwise Comparisons

Measure: task

(I) SBP	(J) SBP	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	2.171*	.556	.000	.825	3.517
	3	5.016*	.588	.000	3.594	6.439
2	1	-2.171*	.556	.000	-3.517	-.825
	3	2.845*	.503	.000	1.627	4.064
3	1	-5.016*	.588	.000	-6.439	-3.594
	2	-2.845*	.503	.000	-4.064	-1.627

Based on estimated marginal means

22.

Estimates

Measure: task

SBP	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
1	120.832	1.042	118.773	122.892
2	118.661	1.068	116.551	120.771
3	115.816	.935	113.968	117.664

23. DBP

Tests of Within-Subjects Effects

Measure: easy_hardtask

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
period	Sphericity Assumed	881.478	2	440.739	12.013	.000	.074
	Greenhouse-Geisser	881.478	1.808	487.663	12.013	.000	.074
	Huynh-Feldt	881.478	1.841	478.933	12.013	.000	.074
	Lower-bound	881.478	1.000	881.478	12.013	.001	.074
period * TASK_difficult_easy	Sphericity Assumed	66.373	2	33.186	.905	.406	.006
	Greenhouse-Geisser	66.373	1.808	36.720	.905	.397	.006
	Huynh-Feldt	66.373	1.841	36.062	.905	.399	.006
	Lower-bound	66.373	1.000	66.373	.905	.343	.006
Error(period)	Sphericity Assumed	11006.149	300	36.687			
	Greenhouse-Geisser	11006.149	271.133	40.593			
	Huynh-Feldt	11006.149	276.075	39.866			
	Lower-bound	11006.149	150.000	73.374			

24.

Pairwise Comparisons

Measure: easy_hardtask

(I) period	(J) period	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	2.842*	.771	.001	.976	4.709
	3	3.046*	.723	.000	1.295	4.797
2	1	-2.842*	.771	.001	-4.709	-.976
	3	.204	.575	1.000	-1.188	1.596
3	1	-3.046*	.723	.000	-4.797	-1.295
	2	-.204	.575	1.000	-1.596	1.188

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

25.

Estimates

Measure: easy_hardtask

period	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	73.086	.804	71.496	74.675
2	70.243	.877	68.510	71.977
3	70.039	.865	68.331	71.748

26. MAP

Tests of Within-Subjects Effects

Measure: easy_hardtask

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
period	Sphericity Assumed	1101.657	2	550.828	27.500	.000	.155
	Greenhouse-Geisser	1101.657	1.783	617.724	27.500	.000	.155
	Huynh-Feldt	1101.657	1.815	606.825	27.500	.000	.155
	Lower-bound	1101.657	1.000	1101.657	27.500	.000	.155
period * TASK_difficult_easy	Sphericity Assumed	61.041	2	30.521	1.524	.220	.010
	Greenhouse-Geisser	61.041	1.783	34.227	1.524	.221	.010
	Huynh-Feldt	61.041	1.815	33.623	1.524	.221	.010
	Lower-bound	61.041	1.000	61.041	1.524	.219	.010
Error(period)	Sphericity Assumed	6008.969	300	20.030			
	Greenhouse-Geisser	6008.969	267.512	22.462			
	Huynh-Feldt	6008.969	272.316	22.066			
	Lower-bound	6008.969	150.000	40.060			

27.

Pairwise Comparisons

Measure: easy_hardtask

(I) period	(J) period	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	2.618*	.572	.000	1.235	4.002
	3	3.703*	.538	.000	2.400	5.006
2	1	-2.618*	.572	.000	-4.002	-1.235
	3	1.084*	.417	.031	.074	2.095
3	1	-3.703*	.538	.000	-5.006	-2.400
	2	-1.084*	.417	.031	-2.095	-.074

28. HR

Tests of Within-Subjects Effects

Measure: easy_hardtask

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
period	Sphericity Assumed	574.799	2	287.400	19.511	.000	.117
	Greenhouse-Geisser	574.799	1.783	322.320	19.511	.000	.117
	Huynh-Feldt	574.799	1.816	316.519	19.511	.000	.117
	Lower-bound	574.799	1.000	574.799	19.511	.000	.117
period * TASK_difficult_easy	Sphericity Assumed	129.993	2	64.997	4.413	.013	.029
	Greenhouse-Geisser	129.993	1.783	72.894	4.413	.016	.029
	Huynh-Feldt	129.993	1.816	71.582	4.413	.016	.029
	Lower-bound	129.993	1.000	129.993	4.413	.037	.029
Error(period)	Sphericity Assumed	4330.619	294	14.730			
	Greenhouse-Geisser	4330.619	262.148	16.520			
	Huynh-Feldt	4330.619	266.953	16.222			
	Lower-bound	4330.619	147.000	29.460			

29.

3. TASK_difficult_easy * period

Measure: easy_hardtask

TASK_difficult_easy	period	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1.00	1	82.411	1.488	79.471	85.350
	2	81.439	1.332	78.805	84.072
	3	80.488	1.231	78.055	82.921
2.00	1	83.401	1.498	80.442	86.361
	2	79.793	1.341	77.142	82.444
	3	80.311	1.239	77.861	82.760

Consideration of covariates

30.

Correlations

		BMI	LOTR_tot	STAI_total	Negative_emotionality	digitspan_score	SysRest_AVER	SysStress_AVER
BMI	Pearson Correlation	1	.039	-.001	-.013	-.067	.412**	.350**
	Sig. (2-tailed)		.631	.992	.875	.414	.000	.000
	N	151	151	151	151	151	151	151
LOTR_tot	Pearson Correlation	.039	1	-.777**	-.660**	.125	.036	.031
	Sig. (2-tailed)	.631		.000	.000	.124	.657	.708
	N	151	152	152	152	152	152	152
STAI_total	Pearson Correlation	-.001	-.777**	1	.839**	-.100	.041	.025
	Sig. (2-tailed)	.992	.000		.000	.221	.613	.761
	N	151	152	152	152	152	152	152
Negative_emotionality	Pearson Correlation	-.013	-.660**	.839**	1	.019	-.003	-.022
	Sig. (2-tailed)	.875	.000	.000		.813	.969	.790
	N	151	152	152	152	152	152	152
digitspan_score	Pearson Correlation	-.067	.125	-.100	.019	1	-.003	.038
	Sig. (2-tailed)	.414	.124	.221	.813		.971	.645
	N	151	152	152	152	152	152	152
SysRest_AVER	Pearson Correlation	.412**	.036	.041	-.003	-.003	1	.811**
	Sig. (2-tailed)	.000	.657	.613	.969	.971		.000
	N	151	152	152	152	152	152	152
SysStress_AVER	Pearson Correlation	.350**	.031	.025	-.022	.038	.811**	1
	Sig. (2-tailed)	.000	.708	.761	.790	.645	.000	
	N	151	152	152	152	152	152	152

**. Correlation is significant at the 0.01 level (2-tailed).

31.

Correlations

		BMI	LOTR_tot	STAI_total	Negative_emotionality	digitspan_score	DiaRest_AVER	DiaStress_AVER
BMI	Pearson Correlation	1	.039	-.001	-.013	-.067	.261**	.253**
	Sig. (2-tailed)		.631	.992	.875	.414	.001	.002
	N	151	151	151	151	151	151	151
LOTR_tot	Pearson Correlation	.039	1	-.777**	-.660**	.125	.006	.089
	Sig. (2-tailed)	.631		.000	.000	.124	.939	.274
	N	151	152	152	152	152	152	152
STAI_total	Pearson Correlation	-.001	-.777**	1	.839**	-.100	.027	.015
	Sig. (2-tailed)	.992	.000		.000	.221	.737	.856
	N	151	152	152	152	152	152	152
Negative_emotionality	Pearson Correlation	-.013	-.660**	.839**	1	.019	-.069	-.078
	Sig. (2-tailed)	.875	.000	.000		.813	.397	.339
	N	151	152	152	152	152	152	152
digitspan_score	Pearson Correlation	-.067	.125	-.100	.019	1	.092	.113
	Sig. (2-tailed)	.414	.124	.221	.813		.258	.165
	N	151	152	152	152	152	152	152
DiaRest_AVER	Pearson Correlation	.261**	.006	.027	-.069	.092	1	.770**
	Sig. (2-tailed)	.001	.939	.737	.397	.258		.000
	N	151	152	152	152	152	152	152
DiaStress_AVER	Pearson Correlation	.253**	.089	.015	-.078	.113	.770**	1
	Sig. (2-tailed)	.002	.274	.856	.339	.165	.000	
	N	151	152	152	152	152	152	152

**. Correlation is significant at the 0.01 level (2-tailed).

32.

Correlations

		BMI	LOTR_tot	STAI_total	Negative_emotionality	MAP_Rest_AVER	MAPTask_AVER	digitspan_score
BMI	Pearson Correlation	1	.039	-.001	-.013	.382**	.347**	-.067
	Sig. (2-tailed)		.631	.992	.875	.000	.000	.414
	N	151	151	151	151	151	151	151
LOTR_tot	Pearson Correlation	.039	1	-.777**	-.660**	.021	.079	.125
	Sig. (2-tailed)	.631		.000	.000	.797	.336	.124
	N	151	152	152	152	152	152	152
STAI_total	Pearson Correlation	-.001	-.777**	1	.839**	.039	.022	-.100
	Sig. (2-tailed)	.992	.000		.000	.632	.786	.221
	N	151	152	152	152	152	152	152
Negative_emotionality	Pearson Correlation	-.013	-.660**	.839**	1	-.053	-.066	.019
	Sig. (2-tailed)	.875	.000	.000		.517	.417	.813
	N	151	152	152	152	152	152	152
MAP_Rest_AVER	Pearson Correlation	.382**	.021	.039	-.053	1	.795**	.067
	Sig. (2-tailed)	.000	.797	.632	.517		.000	.409
	N	151	152	152	152	152	152	152
MAPTask_AVER	Pearson Correlation	.347**	.079	.022	-.066	.795**	1	.099
	Sig. (2-tailed)	.000	.336	.786	.417	.000		.225
	N	151	152	152	152	152	152	152
digitspan_score	Pearson Correlation	-.067	.125	-.100	.019	.067	.099	1
	Sig. (2-tailed)	.414	.124	.221	.813	.409	.225	
	N	151	152	152	152	152	152	152

**. Correlation is significant at the 0.01 level (2-tailed).

33.

Correlations

		BMI	digitspan_score	HRRest_AVER	HRTask_AVER	SDNN_Rest	SDNN_Task
BMI	Pearson Correlation	1	-.067	.006	.023	.029	.035
	Sig. (2-tailed)		.414	.943	.779	.726	.670
	N	151	151	149	148	149	148
digitspan_score	Pearson Correlation	-.067	1	.026	.032	-.006	.052
	Sig. (2-tailed)	.414		.753	.695	.944	.525
	N	151	152	150	149	150	149
HRRest_AVER	Pearson Correlation	.006	.026	1	.837**	-.627**	-.479**
	Sig. (2-tailed)	.943	.753		.000	.000	.000
	N	149	150	150	149	150	149
HRTask_AVER	Pearson Correlation	.023	.032	.837**	1	-.566**	-.552**
	Sig. (2-tailed)	.779	.695	.000		.000	.000
	N	148	149	149	149	149	149
SDNN_Rest	Pearson Correlation	.029	-.006	-.627**	-.566**	1	.664**
	Sig. (2-tailed)	.726	.944	.000	.000		.000
	N	149	150	150	149	150	149
SDNN_Task	Pearson Correlation	.035	.052	-.479**	-.552**	.664**	1
	Sig. (2-tailed)	.670	.525	.000	.000	.000	
	N	148	149	149	149	149	149

**. Correlation is significant at the 0.01 level (2-tailed).

34.

Correlations

		BMI	digitspan_score	HF_Rest	HF_Task	LF_Rest	LF_Task
BMI	Pearson Correlation	1	-.067	.082	-.020	.065	.022
	Sig. (2-tailed)		.414	.321	.809	.431	.790
	N	151	151	149	148	149	148
digitspan_score	Pearson Correlation	-.067	1	-.064	-.036	-.038	.025
	Sig. (2-tailed)	.414		.436	.662	.640	.762
	N	151	152	150	149	150	149
HF_Rest	Pearson Correlation	.082	-.064	1	.053	.513**	.079
	Sig. (2-tailed)	.321	.436		.520	.000	.338
	N	149	150	150	149	150	149
HF_Task	Pearson Correlation	-.020	-.036	.053	1	.246**	.496**
	Sig. (2-tailed)	.809	.662	.520		.002	.000
	N	148	149	149	149	149	149
LF_Rest	Pearson Correlation	.065	-.038	.513**	.246**	1	.458**
	Sig. (2-tailed)	.431	.640	.000	.002		.000
	N	149	150	150	149	150	149
LF_Task	Pearson Correlation	.022	.025	.079	.496**	.458**	1
	Sig. (2-tailed)	.790	.762	.338	.000	.000	
	N	148	149	149	149	149	149

**. Correlation is significant at the 0.01 level (2-tailed).

Cardiovascular Measures at Rest: Group X Task ANCOVAs for resting levels

35. SBP

Tests of Between-Subjects Effects

Dependent Variable: SysRest_AVER

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3108.184[a]	6	518.031	5.338	.000	.182
Intercept	19549.968	1	19549.968	201.465	.000	.583
BMI	2887.340	1	2887.340	29.754	.000	.171
Negative_emotionality	74.931	1	74.931	.772	.381	.005
STAI_total	151.801	1	151.801	1.564	.213	.011
Opt_Pess	49.130	1	49.130	.506	.478	.004
TASK_difficult_easy	24.331	1	24.331	.251	.617	.002
Opt_Pess * TASK_difficult_easy	60.149	1	60.149	.620	.432	.004
Error	13973.604	144	97.039			
Total	1891008.028	151				
Corrected Total	17081.788	150				

a. R Squared = .182 (Adjusted R Squared = .148)

36. DBP

Tests of Between-Subjects Effects

Dependent Variable: DiaRest_AVER

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1078.222[a]	6	179.704	2.508	.024	.095
Intercept	8077.712	1	8077.712	112.735	.000	.439
BMI	718.264	1	718.264	10.024	.002	.065
Negative_emotionality	250.637	1	250.637	3.498	.063	.024
STAI_total	131.669	1	131.669	1.838	.177	.013
Opt_Pess	1.646	1	1.646	.023	.880	.000
TASK_difficult_easy	6.043	1	6.043	.084	.772	.001
Opt_Pess * TASK_difficult_easy	9.539	1	9.539	.133	.716	.001
Error	10317.873	144	71.652			
Total	655299.806	151				
Corrected Total	11396.095	150				

37. MAP

Tests of Between-Subjects Effects

Dependent Variable: MAP_Rest_AVER

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1532.792[a]	6	255.465	4.822	.000	.167
Intercept	11347.461	1	11347.461	214.177	.000	.598
BMI	1280.086	1	1280.086	24.161	.000	.144
Negative_emotionality	180.627	1	180.627	3.409	.067	.023
STAI_total	138.221	1	138.221	2.609	.108	.018
Opt_Pess	2.194	1	2.194	.041	.839	.000
TASK_difficult_easy	2.945E-5	1	2.945E-5	.000	.999	.000
Opt_Pess * TASK_difficult_easy	.277	1	.277	.005	.942	.000
Error	7629.371	144	52.982			
Total	991762.830	151				
Corrected Total	9162.163	150				

a. R Squared = .167 (Adjusted R Squared = .133)

38. HR

Tests of Between-Subjects Effects

Dependent Variable: HRRest_AVER

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	349.700[a]	6	58.283	.491	.814	.020
Intercept	13974.132	1	13974.132	117.674	.000	.453
BMI	.077	1	.077	.001	.980	.000
Negative_emotionality	55.324	1	55.324	.466	.496	.003
STAI_total	177.635	1	177.635	1.496	.223	.010
Opt_Pess	186.808	1	186.808	1.573	.212	.011
TASK_difficult_easy	131.401	1	131.401	1.107	.295	.008
Opt_Pess * TASK_difficult_easy	.006	1	.006	.000	.994	.000
Error	16862.980	142	118.753			
Total	913153.264	149				
Corrected Total	17212.680	148				

a. R Squared = .020 (Adjusted R Squared = -.021)

39. HF-HRV

Tests of Between-Subjects Effects

Dependent Variable: HFRest_transformed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1.149[a]	6	.191	.622	.713	.026
Intercept	26.346	1	26.346	85.552	.000	.376
BMI	.010	1	.010	.033	.856	.000
Negative_emotionality	.004	1	.004	.012	.913	.000
STAI_total	.143	1	.143	.464	.497	.003
Opt_Pess	.106	1	.106	.343	.559	.002
TASK_difficult_easy	.798	1	.798	2.591	.110	.018
Opt_Pess * TASK_difficult_easy	.045	1	.045	.147	.702	.001
Error	43.729	142	.308			
Total	1307.259	149				
Corrected Total	44.878	148				

40. SDNN

Tests of Between-Subjects Effects

Dependent Variable: SDNN_Rest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2251.279[a]	5	450.256	.567	.725	.019
Intercept	31468.797	1	31468.797	39.641	.000	.216
Negative_emotionality	78.597	1	78.597	.099	.753	.001
STAI_total	306.398	1	306.398	.386	.535	.003
Opt_Pess	195.213	1	195.213	.246	.621	.002
TASK_difficult_easy	412.475	1	412.475	.520	.472	.004
Opt_Pess * TASK_difficult_easy	335.116	1	335.116	.422	.517	.003
Error	114314.434	144	793.850			
Total	761164.750	150				
Corrected Total	116565.713	149				

a. R Squared = .019 (Adjusted R Squared = -.015)

41. LF-HRV

Tests of Between-Subjects Effects

Dependent Variable: LFRest_transformed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	.304[a]	5	.061	.478	.792	.016
Intercept	45.792	1	45.792	359.983	.000	.714
Negative_emotionality	.000	1	.000	.004	.951	.000
STAI_total	.037	1	.037	.291	.591	.002
Opt_Pess	.003	1	.003	.022	.882	.000
TASK_difficult_easy	.053	1	.053	.419	.518	.003
Opt_Pess * TASK_difficult_easy	.003	1	.003	.026	.873	.000
Error	18.318	144	.127			
Total	1359.730	150				
Corrected Total	18.622	149				

a. R Squared = .016 (Adjusted R Squared = -.018)

Primary Analyses: Cardiovascular Reactivity to the Task

42. SBP task

Tests of Between-Subjects Effects

Dependent Variable: SysStress_AVER

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	13947.042[a]	7	1992.435	41.210	.000	.669
Intercept	566.226	1	566.226	11.711	.001	.076
SysRest_AVER	11124.763	1	11124.763	230.095	.000	.617
BMI	11.312	1	11.312	.234	.629	.002
STAI_total	29.304	1	29.304	.606	.438	.004
Negative_emotionality	8.693	1	8.693	.180	.672	.001
Opt_Pess	174.815	1	174.815	3.616	.059	.025
TASK_difficult_easy	30.125	1	30.125	.623	.431	.004
Opt_Pess * TASK_difficult_easy	15.891	1	15.891	.329	.567	.002
Error	6913.848	143	48.349			
Total	2134097.167	151				
Corrected Total	20860.890	150				

a. R Squared = .669 (Adjusted R Squared = .652)

43. DBP task

Tests of Between-Subjects Effects

Dependent Variable: DiaStress_AVER

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7487.447[a]	7	1069.635	31.347	.000	.605
Intercept	265.467	1	265.467	7.780	.006	.052
BMI	36.481	1	36.481	1.069	.303	.007
STAI_total	105.411	1	105.411	3.089	.081	.021
Negative_emotionality	22.902	1	22.902	.671	.414	.005
DiaRest_AVER	6234.647	1	6234.647	182.714	.000	.561
Opt_Pess	198.494	1	198.494	5.817	.017	.039
TASK_difficult_easy	23.413	1	23.413	.686	.409	.005
Opt_Pess * TASK_difficult_easy	15.598	1	15.598	.457	.500	.003
Error	4879.517	143	34.122			
Total	773226.667	151				
Corrected Total	12366.964	150				

a. R Squared = .605 (Adjusted R Squared = .586)

44.

Estimates

Dependent Variable: DiaStress_AVER

Opt_Pess	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1.00	72.757[a]	.875	71.027	74.488
2.00	69.326[a]	.836	67.674	70.978

a. Covariates appearing in the model are evaluated at the following values: BMI = 25.4503, STAI_total = 44.9404, Negative_emotionality = 37.3179, DiaRest_AVER = 65.3013.

45. MAP task

Tests of Between-Subjects Effects

Dependent Variable: MAPTask_AVER

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6644.461[a]	7	949.209	34.926	.000	.631
Intercept	310.369	1	310.369	11.420	.001	.074
BMI	30.723	1	30.723	1.130	.289	.008
STAI_total	25.195	1	25.195	.927	.337	.006
Negative_emotionality	15.597	1	15.597	.574	.450	.004
MAP_Rest_AVER	5108.408	1	5108.408	187.961	.000	.568
Opt_Pess	26.889	1	26.889	.989	.322	.007
TASK_difficult_easy	2.510	1	2.510	.092	.762	.001
Opt_Pess * TASK_difficult_easy	17.989	1	17.989	.662	.417	.005
Error	3886.451	143	27.178			
Total	1147059.537	151				
Corrected Total	10530.913	150				

a. R Squared = .631 (Adjusted R Squared = .613)

46. HR task

Tests of Between-Subjects Effects

Dependent Variable: HRTask_AVER

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	12799.893[a]	7	1828.556	47.885	.000	.705
Intercept	353.095	1	353.095	9.247	.003	.062
BMI	14.438	1	14.438	.378	.540	.003
STAI_total	32.926	1	32.926	.862	.355	.006
Negative_emotionality	1.836	1	1.836	.048	.827	.000
HRRest_AVER	12672.739	1	12672.739	331.865	.000	.703
Opt_Pess	23.962	1	23.962	.628	.430	.004
TASK_difficult_easy	27.625	1	27.625	.723	.396	.005
Opt_Pess * TASK_difficult_easy	12.979	1	12.979	.340	.561	.002
Error	5346.097	140	38.186			
Total	997887.993	148				
Corrected Total	18145.990	147				

a. R Squared = .705 (Adjusted R Squared = .691)

47. HF-HRV

Tests of Between-Subjects Effects

Dependent Variable: HFTask_transformed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	19.263[a]	7	2.752	21.768	.000	.521
Intercept	1.315	1	1.315	10.399	.002	.069
BMI	.075	1	.075	.591	.443	.004
STAI_total	.059	1	.059	.468	.495	.003
Negative_emotionality	.415	1	.415	3.283	.072	.023
HFRest_transformed	17.481	1	17.481	138.281	.000	.497
Opt_Pess	.001	1	.001	.005	.945	.000
TASK_difficult_easy	.265	1	.265	2.095	.150	.015
Opt_Pess * TASK_difficult_easy	.001	1	.001	.010	.922	.000
Error	17.698	140	.126			
Total	1210.823	148				
Corrected Total	36.962	147				

a. R Squared = .521 (Adjusted R Squared = .497)

48. SDNN

Tests of Between-Subjects Effects

Dependent Variable: SDNN_Task

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	75853.425[a]	7	10836.204	18.541	.000	.481
Intercept	400.189	1	400.189	.685	.409	.005
BMI	3.512	1	3.512	.006	.938	.000
STAI_total	219.852	1	219.852	.376	.541	.003
Negative_emotionality	521.283	1	521.283	.892	.347	.006
SDNN_Rest	68271.791	1	68271.791	116.816	.000	.455
Opt_Pess	216.274	1	216.274	.370	.544	.003
TASK_difficult_easy	2905.690	1	2905.690	4.972	.027	.034
Opt_Pess * TASK_difficult_easy	1905.922	1	1905.922	3.261	.073	.023
Error	81821.618	140	584.440			
Total	735125.240	148				
Corrected Total	157675.043	147				

49.

Estimates

Dependent Variable: SDNN_Task

TASK_difficult_easy	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
1.00	57.996[a]	2.834	52.392	63.599
2.00	66.983[a]	2.827	61.394	72.572

a. Covariates appearing in the model are evaluated at the following values: BMI = 25.4595, STAI_total = 44.6892, Negative_emotionality = 37.0946, SDNN_Rest = 65.7845.

50. LF-HRV

Tests of Between-Subjects Effects

Dependent Variable: LFTask_transformed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	8.728[a]	7	1.247	17.416	.000	.465
Intercept	1.390	1	1.390	19.422	.000	.122
BMI	.029	1	.029	.404	.526	.003
STAI_total	.054	1	.054	.755	.386	.005
Negative_emotionality	.142	1	.142	1.983	.161	.014
LFRest_transformed	7.641	1	7.641	106.735	.000	.433
Opt_Pess	.078	1	.078	1.091	.298	.008
TASK_difficult_easy	.585	1	.585	8.165	.005	.055
Opt_Pess * TASK_difficult_easy	.091	1	.091	1.272	.261	.009
Error	10.023	140	.072			
Total	1293.237	148				
Corrected Total	18.751	147				

a. R Squared = .465 (Adjusted R Squared = .439)

51.

Estimates

Dependent Variable: LF_Task

TASK_difficult_easy	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
1.00	969.945[a]	118.068	736.518	1203.373
2.00	1427.468[a]	117.781	1194.608	1660.328

Comparisons of Reactivity during the first minute of the task

52. SBP

Tests of Between-Subjects Effects

Dependent Variable: SysStress_0min

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	13482.590[a]	7	1926.084	25.024	.000	.551
Intercept	959.109	1	959.109	12.461	.001	.080
BMI	47.379	1	47.379	.616	.434	.004
STAI_total	62.911	1	62.911	.817	.367	.006
Negative_emotionality	13.789	1	13.789	.179	.673	.001
SysRest_AVER	10275.767	1	10275.767	133.506	.000	.483
Opt_Pess	276.424	1	276.424	3.591	.060	.024
TASK_difficult_easy	.213	1	.213	.003	.958	.000
Opt_Pess * TASK_difficult_easy	17.110	1	17.110	.222	.638	.002
Error	11006.545	143	76.969			
Total	2224524.250	151				
Corrected Total	24489.136	150				

a. R Squared = .551 (Adjusted R Squared = .529)

53. DBP

Tests of Between-Subjects Effects

Dependent Variable: DiaStress_0min

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6088.586[a]	7	869.798	14.874	.000	.421
Intercept	624.387	1	624.387	10.678	.001	.069
BMI	87.460	1	87.460	1.496	.223	.010
STAI_total	35.956	1	35.956	.615	.434	.004
Negative_emotionality	.012	1	.012	.000	.989	.000
DiaRest_AVER	4775.095	1	4775.095	81.659	.000	.363
Opt_Pess	141.745	1	141.745	2.424	.122	.017
TASK_difficult_easy	93.317	1	93.317	1.596	.209	.011
Opt_Pess * TASK_difficult_easy	30.990	1	30.990	.530	.468	.004
Error	8362.089	143	58.476			
Total	818108.000	151				
Corrected Total	14450.676	150				

a. R Squared = .421 (Adjusted R Squared = .393)

54. MAP

Tests of Between-Subjects Effects

Dependent Variable: MAPTask_0

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	5581.146[a]	7	797.307	19.207	.000	.485
Intercept	738.622	1	738.622	17.793	.000	.111
BMI	102.180	1	102.180	2.461	.119	.017
STAI_total	2.812	1	2.812	.068	.795	.000
Negative_emotionality	1.457	1	1.457	.035	.852	.000
MAP_Rest_AVER	3893.542	1	3893.542	93.794	.000	.396
Opt_Pess	7.558	1	7.558	.182	.670	.001
TASK_difficult_easy	43.285	1	43.285	1.043	.309	.007
Opt_Pess * TASK_difficult_easy	21.663	1	21.663	.522	.471	.004
Error	5936.142	143	41.511			
Total	1204119.806	151				
Corrected Total	11517.287	150				

a. R Squared = .485 (Adjusted R Squared = .459)

55. HR

Tests of Between-Subjects Effects

Dependent Variable: HRTask_0

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	13940.351[a]	6	2323.392	31.439	.000	.571
Intercept	661.270	1	661.270	8.948	.003	.059
STAI_total	99.533	1	99.533	1.347	.248	.009
Negative_emotionality	4.365	1	4.365	.059	.808	.000
HRRest_AVER	13806.696	1	13806.696	186.826	.000	.568
Opt_Pess	107.170	1	107.170	1.450	.231	.010
TASK_difficult_easy	258.865	1	258.865	3.503	.063	.024
Opt_Pess * TASK_difficult_easy	32.669	1	32.669	.442	.507	.003
Error	10494.018	142	73.902			
Total	1048488.122	149				
Corrected Total	24434.369	148				

Comparisons of Reactivity between "true pessimists" and "slight pessimists."

56. SBP

Tests of Between-Subjects Effects[a]

Dependent Variable: SysStress_AVER

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7129.241[b]	5	1425.848	26.384	.000	.647
Intercept	325.632	1	325.632	6.026	.017	.077
BMI	17.441	1	17.441	.323	.572	.004
STAI_total	11.200	1	11.200	.207	.650	.003
Negative_emotionality	127.120	1	127.120	2.352	.129	.032
SysRest_AVER	5468.712	1	5468.712	101.194	.000	.584
true_Pessimist	292.502	1	292.502	5.413	.023	.070
Error	3890.998	72	54.042			
Total	1111535.944	78				
Corrected Total	11020.239	77				

a. Opt_Pess = 2.00

b. R Squared = .647 (Adjusted R Squared = .622)

57.

Estimates[a]

Dependent Variable: SysStress_AVER

true_Pessimist	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
true pessimist (under 12)	116.101[b]	1.421	113.268	118.935
slight pessimist (13-17)	120.283[b]	1.053	118.184	122.383

a. Opt_Pess = 2.00

b. Covariates appearing in the model are evaluated at the following values: BMI = 25.3462, STAI_total = 53.4615, Negative_emotionality = 43.5000, SysRest_AVER = 111.2885.

58. DBP

Tests of Between-Subjects Effects[a]

Dependent Variable: DiaStress_AVER

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3798.792[b]	5	759.758	20.637	.000	.589
Intercept	310.138	1	310.138	8.424	.005	.105
BMI	26.997	1	26.997	.733	.395	.010
STAI_total	6.443	1	6.443	.175	.677	.002
Negative_emotionality	45.714	1	45.714	1.242	.269	.017
DiaRest_AVER	2654.310	1	2654.310	72.099	.000	.500
true_Pessimist	13.296	1	13.296	.361	.550	.005
Error	2650.651	72	36.815			
Total	392251.222	78				
Corrected Total	6449.443	77				

a. Opt_Pess = 2.00

b. R Squared = .589 (Adjusted R Squared = .560)

59. MAP

Tests of Between-Subjects Effects[a]

Dependent Variable: MAPTask_AVER

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3246.396[b]	5	649.279	23.166	.000	.617
Intercept	310.211	1	310.211	11.068	.001	.133
BMI	28.773	1	28.773	1.027	.314	.014
STAI_total	.825	1	.825	.029	.864	.000
Negative_emotionality	62.785	1	62.785	2.240	.139	.030
MAP_Rest_AVER	2002.917	1	2002.917	71.464	.000	.498
true_Pessimist	67.572	1	67.572	2.411	.125	.032
Error	2017.944	72	28.027			
Total	588610.759	78				
Corrected Total	5264.339	77				

a. Opt_Pess = 2.00

b. R Squared = .617 (Adjusted R Squared = .590)

60. HR

Tests of Between-Subjects Effects[a]

Dependent Variable: HRTask_AVER

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7047.275[b]	5	1409.455	33.124	.000	.706
Intercept	81.055	1	81.055	1.905	.172	.027
BMI	5.923	1	5.923	.139	.710	.002
STAI_total	8.068	1	8.068	.190	.665	.003
Negative_emotionality	3.544	1	3.544	.083	.774	.001
HRRest_AVER	6319.910	1	6319.910	148.525	.000	.683
true_Pessimist	55.015	1	55.015	1.293	.259	.018
Error	2936.039	69	42.551			
Total	499453.570	75				
Corrected Total	9983.314	74				

a. Opt_Pess = 2.00

b. R Squared = .706 (Adjusted R Squared = .685)

61. HF-HRV

Tests of Between-Subjects Effects[a]

Dependent Variable: HFTask_transformed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	14.682[b]	5	2.936	32.012	.000	.699
Intercept	.130	1	.130	1.417	.238	.020
BMI	6.652E-8	1	6.652E-8	.000	.999	.000
STAI_total	.090	1	.090	.977	.326	.014
Negative_emotionality	.134	1	.134	1.459	.231	.021
HFRest_transformed	13.681	1	13.681	149.146	.000	.684
true_Pessimist	.313	1	.313	3.413	.069	.047
Error	6.329	69	.092			
Total	622.467	75				
Corrected Total	21.012	74				

a. Opt_Pess = 2.00

b. R Squared = .699 (Adjusted R Squared = .677)

62. SDNN

Tests of Between-Subjects Effects[a]

Dependent Variable: SDNN_Task

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	48801.619[b]	5	9760.324	9.483	.000	.407
Intercept	271.325	1	271.325	.264	.609	.004
BMI	9.680	1	9.680	.009	.923	.000
STAI_total	320.169	1	320.169	.311	.579	.004
Negative_emotionality	1102.403	1	1102.403	1.071	.304	.015
SDNN_Rest	45150.147	1	45150.147	43.865	.000	.389
true_Pessimist	15.413	1	15.413	.015	.903	.000
Error	71020.788	69	1029.287			
Total	416993.620	75				
Corrected Total	119822.407	74				

a. Opt_Pess = 2.00

b. R Squared = .407 (Adjusted R Squared = .364)

63. LF-HRV

Tests of Between-Subjects Effects[a]

Dependent Variable: LFTask_transformed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	5.739[b]	5	1.148	12.170	.000	.469
Intercept	.277	1	.277	2.941	.091	.041
BMI	.000	1	.000	.005	.944	.000
STAI_total	.218	1	.218	2.308	.133	.032
Negative_emotionality	.364	1	.364	3.858	.054	.053
LFRest_transformed	5.217	1	5.217	55.311	.000	.445
true_Pessimist	.068	1	.068	.722	.398	.010
Error	6.508	69	.094			
Total	660.880	75				
Corrected Total	12.247	74				

a. Opt_Pess = 2.00

b. R Squared = .469 (Adjusted R Squared = .430)

Primary Analyses: Cardiovascular Recovery from Stress

64. SBP

Tests of Between-Subjects Effects

Dependent Variable: SYS_AUC

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	39215146.570[a]	7	5602163.796	1.390	.214	.064
Intercept	398591.004	1	398591.004	.099	.754	.001
STAI_total	2533597.244	1	2533597.244	.628	.429	.004
Negative_emotionality	1062499.419	1	1062499.419	.264	.608	.002
BMI	12557984.110	1	12557984.110	3.115	.080	.021
SysStress_AVER	12597162.610	1	12597162.610	3.125	.079	.021
Opt_Pess	3029503.733	1	3029503.733	.751	.387	.005
TASK_difficult_easy	12197494.950	1	12197494.950	3.026	.084	.021
Opt_Pess * TASK_difficult_easy	1242963.196	1	1242963.196	.308	.580	.002
Error	576476618.100	143	4031305.022			
Total	648063891.400	151				
Corrected Total	615691764.700	150				

a. R Squared = .064 (Adjusted R Squared = .018)

65. DBP

Tests of Between-Subjects Effects

Dependent Variable: DIA_AUC

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	38107035.140[a]	7	5443862.162	1.262	.273	.058
Intercept	471369.774	1	471369.774	.109	.741	.001
STAI_total	8634407.998	1	8634407.998	2.002	.159	.014
Negative_emotionality	1084364.339	1	1084364.339	.251	.617	.002
BMI	4268365.734	1	4268365.734	.990	.321	.007
DiaStress_AVER	919224.646	1	919224.646	.213	.645	.001
Opt_Pess	6710398.950	1	6710398.950	1.556	.214	.011
TASK_difficult_easy	16136766.750	1	16136766.750	3.742	.055	.026
Opt_Pess * TASK_difficult_easy	7821003.301	1	7821003.301	1.814	.180	.013
Error	616644953.200	143	4312202.470			
Total	720084816.000	151				
Corrected Total	654751988.300	150				

a. R Squared = .058 (Adjusted R Squared = .012)

66. MAP

Tests of Between-Subjects Effects

Dependent Variable: MAP_AUC

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	22657149.450[a]	7	3236735.636	1.207	.302	.056
Intercept	1815829.473	1	1815829.473	.677	.412	.005
STAI_total	1458680.062	1	1458680.062	.544	.462	.004
Negative_emotionality	20358.091	1	20358.091	.008	.931	.000
BMI	8109658.633	1	8109658.633	3.025	.084	.021
MAPTask_AVER	6800919.197	1	6800919.197	2.537	.113	.017
Opt_Pess	997722.350	1	997722.350	.372	.543	.003
TASK_difficult_easy	2187783.939	1	2187783.939	.816	.368	.006
Opt_Pess * TASK_difficult_easy	4892314.840	1	4892314.840	1.825	.179	.013
Error	383365832.600	143	2680879.949			
Total	459096129.400	151				
Corrected Total	406022982.100	150				

a. R Squared = .056 (Adjusted R Squared = .010)

67. HR

Tests of Between-Subjects Effects

Dependent Variable: HR_AUC

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3040709.367[a]	6	506784.895	.376	.893	.016
Intercept	787556.097	1	787556.097	.585	.446	.004
STAI_total	62596.138	1	62596.138	.046	.830	.000
Negative_emotionality	23332.378	1	23332.378	.017	.895	.000
HRTask_AVER	114434.578	1	114434.578	.085	.771	.001
Opt_Pess	128.019	1	128.019	.000	.992	.000
TASK_difficult_easy	2637693.656	1	2637693.656	1.958	.164	.014
Opt_Pess * TASK_difficult_easy	158201.371	1	158201.371	.117	.732	.001
Error	191300809.400	142	1347188.798			
Total	216243857.200	149				
Corrected Total	194341518.700	148				

68. HF-HRV

Tests of Between-Subjects Effects

Dependent Variable: HFRecov_transformed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	23.041[a]	6	3.840	38.002	.000	.616
Intercept	1.593	1	1.593	15.766	.000	.100
STAI_total	7.943E-7	1	7.943E-7	.000	.998	.000
Negative_emotionality	.177	1	.177	1.753	.188	.012
HFTask_transformed	22.476	1	22.476	222.419	.000	.610
Opt_Pess	.024	1	.024	.234	.630	.002
TASK_difficult_easy	.068	1	.068	.670	.415	.005
Opt_Pess * TASK_difficult_easy	.008	1	.008	.078	.781	.001
Error	14.350	142	.101			
Total	1249.507	149				
Corrected Total	37.391	148				

a. R Squared = .616 (Adjusted R Squared = .600)

69. SDNN

Tests of Between-Subjects Effects

Dependent Variable: SDNN_Recov

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	38800.089[a]	6	6466.681	14.945	.000	.387
Intercept	6562.106	1	6562.106	15.165	.000	.096
STAI_total	214.311	1	214.311	.495	.483	.003
Negative_emotionality	47.812	1	47.812	.110	.740	.001
SDNN_Task	37210.995	1	37210.995	85.996	.000	.377
Opt_Pess	17.449	1	17.449	.040	.841	.000
TASK_difficult_easy	316.669	1	316.669	.732	.394	.005
Opt_Pess * TASK_difficult_easy	952.249	1	952.249	2.201	.140	.015
Error	61444.359	142	432.707			
Total	745821.490	149				
Corrected Total	100244.448	148				

a. R Squared = .387 (Adjusted R Squared = .361)

70. LF-HRV

Tests of Between-Subjects Effects

Dependent Variable: LFRecov_transformed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	8.972[a]	6	1.495	19.439	.000	.451
Intercept	1.224	1	1.224	15.909	.000	.101
STAI_total	.012	1	.012	.156	.693	.001
Negative_emotionality	.024	1	.024	.311	.578	.002
LFTask_transformed	8.734	1	8.734	113.546	.000	.444
Opt_Pess	.108	1	.108	1.401	.238	.010
TASK_difficult_easy	.450	1	.450	5.844	.017	.040
Opt_Pess * TASK_difficult_easy	.007	1	.007	.089	.766	.001
Error	10.923	142	.077			
Total	1385.335	149				
Corrected Total	19.894	148				

a. R Squared = .451 (Adjusted R Squared = .428)

71.

Estimates

Dependent Variable: LF_Recov

TASK_difficult_easy	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1.00	1614.361[a]	135.263	1346.972	1881.750
2.00	1330.363[a]	136.053	1061.413	1599.313

a. Covariates appearing in the model are evaluated at the following values: STAI_total = 44.7383, Negative_emotionality = 37.1007, LF_Task = 1198.5570.

Task Score

72.

Tests of Between-Subjects Effects

Dependent Variable: Stress_Task_score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1943.770[a]	4	485.943	205.759	.000	.848
Intercept	119.622	1	119.622	50.651	.000	.256
digitspan_score	.055	1	.055	.023	.879	.000
Opt_Pess	.561	1	.561	.237	.627	.002
TASK_difficult_easy	1909.246	1	1909.246	808.419	.000	.846
Opt_Pess * TASK_difficult_easy	3.446	1	3.446	1.459	.229	.010
Error	347.170	147	2.362			
Total	7799.000	152				
Corrected Total	2290.941	151				

a. R Squared = .848 (Adjusted R Squared = .844)

73.

Estimates

Dependent Variable: Stress_Task_score

TASK_difficult_easy	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Difficult	2.452[a]	.177	2.102	2.801
Easy	9.584[a]	.177	9.235	9.934

a. Covariates appearing in the model are evaluated at the following values: digitspan_score = 63.5329.

74. True Optimists vs. True pessimists task score

Tests of Between-Subjects Effects

Dependent Variable: Stress_Task_score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	886.588[a]	4	221.647	94.233	.000	.859
Intercept	50.816	1	50.816	21.605	.000	.258
digitspan_score	.283	1	.283	.120	.730	.002
true_Pessimist	5.587	1	5.587	2.375	.128	.037
TASK_difficult_easy	803.448	1	803.448	341.587	.000	.846
true_Pessimist * TASK_difficult_easy	5.616	1	5.616	2.388	.127	.037
Error	145.830	62	2.352			
Total	3703.000	67				
Corrected Total	1032.418	66				

a. R Squared = .859 (Adjusted R Squared = .850)

75.

Estimates

Dependent Variable: Stress_Task_score

TASK_difficult_easy	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1.00	2.364[a]	.288	1.789	2.939
2.00	9.583[a]	.258	9.066	10.099

a. Covariates appearing in the model are evaluated at the following values: digitspan_score = 63.2090.

76. DBP with Task score covariate

Tests of Between-Subjects Effects

Dependent Variable: DiaStress_AVER

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7533.704[a]	8	941.713	27.667	.000	.609
Intercept	311.285	1	311.285	9.145	.003	.061
BMI	27.066	1	27.066	.795	.374	.006
STAI_total	118.845	1	118.845	3.492	.064	.024
Negative_emotionality	23.341	1	23.341	.686	.409	.005
DiaRest_AVER	6244.487	1	6244.487	183.462	.000	.564
Stress_Task_score	46.257	1	46.257	1.359	.246	.009
Opt_Pess	212.864	1	212.864	6.254	.014	.042
TASK_difficult_easy	18.932	1	18.932	.556	.457	.004
Opt_Pess * TASK_difficult_easy	10.440	1	10.440	.307	.581	.002
Error	4833.260	142	34.037			
Total	773226.667	151				
Corrected Total	12366.964	150				

a. R Squared = .609 (Adjusted R Squared = .587)

Measures of Affect

77. Positive affect

Tests of Between-Subjects Effects

Dependent Variable: PosAffect_transformed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	50.628[a]	3	16.876	30.119	.000	.379
Intercept	310.349	1	310.349	553.899	.000	.789
Opt_Pess	19.815	1	19.815	35.364	.000	.193
TASK_difficult_easy	30.801	1	30.801	54.972	.000	.271
Opt_Pess * TASK_difficult_easy	.001	1	.001	.002	.962	.000
Error	82.924	148	.560			
Total	440.000	152				
Corrected Total	133.552	151				

a. R Squared = .379 (Adjusted R Squared = .367)

78.

Estimates

Dependent Variable: MAACl_R_pos

Opt_Pess	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Optimist	4.027	.274	3.486	4.568
Pessimist	1.821	.267	1.293	2.348

79.

Estimates

Dependent Variable: MAACl_R_pos

TASK_difficult_easy	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Difficult	1.666	.270	1.131	2.200
Easy	4.182	.270	3.648	4.716

80. Negative Affect

Tests of Between-Subjects Effects

Dependent Variable: NegAffect_transformed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	20.377[a]	3	6.792	9.437	.000	.161
Intercept	444.832	1	444.832	618.052	.000	.807
Opt_Pess	3.113	1	3.113	4.325	.039	.028
TASK_difficult_easy	16.348	1	16.348	22.713	.000	.133
Opt_Pess * TASK_difficult_easy	1.131	1	1.131	1.572	.212	.011
Error	106.520	148	.720			
Total	574.000	152				
Corrected Total	126.898	151				

a. R Squared = .161 (Adjusted R Squared = .144)

81.

Estimates

Dependent Variable: MAACL_r_dys

Opt_Pess	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Optimist	3.324	.351	2.631	4.018
Pessimist	4.205	.342	3.530	4.880

82.

Estimates

Dependent Variable: MAACL_r_dys

TASK_difficult_easy	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Difficult	4.953	.346	4.269	5.637
Easy	2.576	.346	1.892	3.261

Post-experimental questionnaire

83.

Tests of Between-Subjects Effects

Dependent Variable: How_Stressful_was_task

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	49.970[a]	3	16.657	23.012	.000	.318
Intercept	1265.588	1	1265.588	1748.437	.000	.922
Opt_Pess	.588	1	.588	.812	.369	.005
TASK_difficult_easy	47.008	1	47.008	64.942	.000	.305
Opt_Pess * TASK_difficult_easy	1.850	1	1.850	2.556	.112	.017
Error	107.128	148	.724			
Total	1425.000	152				
Corrected Total	157.099	151				

a. R Squared = .318 (Adjusted R Squared = .304)

84.

Estimates

Dependent Variable: How_Stressful_was_task

TASK_difficult_easy	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
Difficult	3.443	.098	3.250	3.636
Easy	2.330	.098	2.137	2.523

85.

Tests of Between-Subjects Effects

Dependent Variable: How_Difficult_were_problems

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	120.197[a]	3	40.066	64.890	.000	.568
Intercept	1803.318	1	1803.318	2920.614	.000	.952
Opt_Pess	.686	1	.686	1.112	.293	.007
TASK_difficult_easy	117.379	1	117.379	190.105	.000	.562
Opt_Pess * TASK_difficult_easy	1.379	1	1.379	2.234	.137	.015
Error	91.382	148	.617			
Total	2018.000	152				
Corrected Total	211.579	151				

a. R Squared = .568 (Adjusted R Squared = .559)

86.

Estimates

Dependent Variable: How_Difficult_were_problems

TASK_difficult_easy	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
difficult	4.325	.090	4.146	4.503
easy	2.567	.090	2.388	2.745

87.

Tests of Between-Subjects Effects

Dependent Variable: How_much_effort_to_complete_tasks

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	11.233[a]	3	3.744	6.170	.001	.111
Intercept	2336.915	1	2336.915	3850.636	.000	.963
Opt_Pess	.389	1	.389	.641	.425	.004
TASK_difficult_easy	10.423	1	10.423	17.174	.000	.104
Opt_Pess * TASK_difficult_easy	.318	1	.318	.524	.470	.004
Error	89.820	148	.607			
Total	2438.000	152				
Corrected Total	101.053	151				

88.

Estimates

Dependent Variable: How_much_effort_to_complete_tasks

TASK_difficult_easy	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
difficult	4.184	.089	4.008	4.361
easy	3.660	.089	3.484	3.837

89.

Tests of Between-Subjects Effects

Dependent Variable: How_Well_did_you_perform_on_task

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	186.599[a]	3	62.200	110.876	.000	.692
Intercept	1049.622	1	1049.622	1871.037	.000	.927
Opt_Pess	3.043	1	3.043	5.425	.021	.035
TASK_difficult_easy	183.550	1	183.550	327.192	.000	.689
Opt_Pess * TASK_difficult_easy	.076	1	.076	.135	.714	.001
Error	83.026	148	.561			
Total	1317.000	152				
Corrected Total	269.625	151				

a. R Squared = .692 (Adjusted R Squared = .686)

90.

Estimates

Dependent Variable: How_Well_did_you_perform_on_task

Opt_Pess	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1.00	2.770	.087	2.598	2.942
2.00	2.487	.085	2.320	2.655

91.

Estimates

Dependent Variable: How_Well_did_you_perform_on_task

TASK_difficult_easy	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
difficult	1.529	.086	1.360	1.699
easy	3.728	.086	3.558	3.898

92.

Tests of Between-Subjects Effects

Dependent Variable: How_persistent_were_you_on_task

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	23.093[a]	3	7.698	9.338	.000	.159
Intercept	2302.157	1	2302.157	2792.653	.000	.950
Opt_Pess	5.367	1	5.367	6.511	.012	.042
TASK_difficult_easy	16.930	1	16.930	20.537	.000	.122
Opt_Pess * TASK_difficult_easy	.614	1	.614	.745	.389	.005
Error	122.006	148	.824			
Total	2443.000	152				
Corrected Total	145.099	151				

a. R Squared = .159 (Adjusted R Squared = .142)

93.

Estimates

Dependent Variable: How_persistent_were_you_on_task

Opt_Pess	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Optimist	4.081	.106	3.873	4.290
Pessimist	3.705	.103	3.502	3.908

94.

Estimates

Dependent Variable: How_persistent_were_you_on_task

TASK_difficult_easy	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
difficult	3.559	.104	3.353	3.765
easy	4.227	.104	4.021	4.433

95.

Tests of Between-Subjects Effects

Dependent Variable: How_upset_are_you_about_performance_on_task

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	37.988[a]	3	12.663	11.605	.000	.190
Intercept	757.523	1	757.523	694.262	.000	.824
Opt_Pess	2.918	1	2.918	2.674	.104	.018
TASK_difficult_easy	33.781	1	33.781	30.959	.000	.173
Opt_Pess * TASK_difficult_easy	.965	1	.965	.884	.349	.006
Error	161.486	148	1.091			
Total	960.000	152				
Corrected Total	199.474	151				

a. R Squared = .190 (Adjusted R Squared = .174)

96.

Estimates

Dependent Variable: How_upset_are_you_about_performance_on_task

			95% Confidence Interval	
TASK_difficult_easy	Mean	Std. Error	Lower Bound	Upper Bound
difficult	2.705	.120	2.468	2.942
easy	1.762	.120	1.525	1.998

Self-Efficacy Ratings

97.

Tests of Between-Subjects Effects

Dependent Variable: Self_efficacy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	.090[a]	3	.030	.116	.951	.002
Intercept	1974.775	1	1974.775	7645.775	.000	.981
Opt_Pess	.039	1	.039	.149	.700	.001
TASK_difficult_easy	.025	1	.025	.097	.756	.001
Opt_Pess * TASK_difficult_easy	.025	1	.025	.097	.756	.001
Error	38.226	148	.258			
Total	2014.000	152				
Corrected Total	38.316	151				

a. R Squared = .002 (Adjusted R Squared = -.018)

Self-efficacy and digit-symbol predicting task score.

98. Difficult task

Coefficients[a,b]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-.401	1.867		-.215	.830
	Self_efficacy	.416	.403	.119	1.033	.305
	digitspan_score	.021	.020	.124	1.076	.285

b. Dependent Variable: Stress_Task_score

99. Easy task

Coefficients[a,b]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	8.613	1.360		6.336	.000
	Self_efficacy	.735	.282	.288	2.610	.011
	digitspan_score	-.026	.015	-.191	-1.730	.088

b. Dependent Variable: Stress_Task_score

Analysis of Optimism and Pessimism Subscales

100. SBP

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	19.085	6.345		3.008	.003
	BMI	.043	.121	.019	.357	.721
	SysRest_AVER	.887	.059	.803	15.074	.000
	STAI_total	.015	.088	.015	.166	.869
	Negative_emotionality	-.036	.100	-.032	-.358	.721
2	(Constant)	22.032	8.167		2.698	.008
	BMI	.089	.123	.039	.723	.471
	SysRest_AVER	.882	.059	.798	14.978	.000
	STAI_total	.005	.106	.006	.051	.959
	Negative_emotionality	-.069	.101	-.062	-.685	.494
	TASK_difficult_easy	.444	1.153	.019	.385	.700
	LOTR_opt	-.575	.301	-.153	-1.906	.059
	LOTR_pes	.357	.259	.110	1.379	.170

a. Dependent Variable: SysStress_AVER

101. DBP

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	18.396	4.403		4.178	.000
	DiaRest_AVER	.774	.058	.743	13.308	.000
	BMI	.102	.097	.058	1.057	.292
	STAI_total	.035	.075	.046	.468	.640
	Negative_emotionality	-.057	.086	-.066	-.664	.507
2	(Constant)	10.292	6.196		1.661	.099
	DiaRest_AVER	.769	.057	.738	13.539	.000
	BMI	.115	.096	.066	1.200	.232
	STAI_total	.169	.088	.222	1.911	.058
	Negative_emotionality	-.077	.085	-.089	-.909	.365
	TASK_difficult_easy	-1.010	.954	-.056	-1.058	.292
	LOTR_opt	-.147	.250	-.051	-.589	.557
	LOTR_pes	.653	.214	.260	3.054	.003

a. Dependent Variable: DiaStress_AVER

102. MAP

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	18.954	4.746		3.993	.000
	BMI	.088	.089	.055	.996	.321
	STAI_total	.025	.066	.036	.379	.705
	Negative_emotionality	-.045	.075	-.056	-.599	.550
	MAP_Rest_AVER	.820	.059	.764	13.797	.000
2	(Constant)	14.960	6.049		2.473	.015
	BMI	.117	.089	.072	1.317	.190
	STAI_total	.114	.078	.163	1.462	.146
	Negative_emotionality	-.071	.075	-.089	-.951	.343
	MAP_Rest_AVER	.807	.058	.752	13.813	.000
	TASK_difficult_easy	-.559	.842	-.033	-.663	.508
	LOTR_opt	-.288	.221	-.108	-1.307	.193
	LOTR_pes	.561	.189	.242	2.967	.004

103. HR

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	16.059	4.122		3.896	.000
	STAI_total	-.054	.077	-.058	-.701	.485
	Negative_emotionality	.028	.088	.027	.321	.749
	HRRest_AVER	.860	.047	.838	18.495	.000
2	(Constant)	14.603	6.263		2.332	.021
	STAI_total	-.028	.093	-.030	-.296	.768
	Negative_emotionality	.006	.089	.006	.069	.945
	HRRest_AVER	.865	.047	.843	18.399	.000
	TASK_difficult_easy	.550	1.019	.025	.540	.590
	LOTR_opt	-.270	.264	-.076	-1.024	.307
	LOTR_pes	.293	.228	.095	1.283	.202

a. Dependent Variable: HRTask_AVER

104. HF-HRV

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.744	.198		3.751	.000
	STAI_total	-.004	.004	-.092	-.864	.389
	Negative_emotionality	.010	.005	.207	1.950	.053
	HFRest_transformed	.645	.053	.708	12.162	.000
2	(Constant)	.762	.344		2.214	.028
	STAI_total	-.006	.005	-.152	-1.195	.234
	Negative_emotionality	.010	.005	.219	2.041	.043
	HFRest_transformed	.635	.053	.697	11.923	.000
	TASK_difficult_easy	.098	.059	.099	1.671	.097
	LOTR_opt	.012	.015	.075	.793	.429
	LOTR_pes	-.019	.013	-.134	-1.421	.157

a. Dependent Variable: HFTask_transformed

105. SDNN

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	7.142	9.690		.737	.462
	STAI_total	.449	.309	.164	1.453	.148
	Negative_emotionality	-.428	.351	-.137	-1.219	.225
	SDNN_Rest	.778	.072	.668	10.778	.000
2	(Constant)	-.206	21.886		-.009	.992
	STAI_total	.467	.368	.171	1.268	.207
	Negative_emotionality	-.516	.353	-.166	-1.462	.146
	SDNN_Rest	.775	.072	.665	10.741	.000
	TASK_difficult_easy	8.385	4.040	.129	2.075	.040
	LOTR_opt	-.769	1.044	-.074	-.737	.462
	LOTR_pes	.586	.909	.064	.644	.520

a. Dependent Variable: SDNN_Task

106. LF-HRV

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.918	.219		4.193	.000
	STAI_total	.007	.003	.220	1.911	.058
	Negative_emotionality	-.006	.004	-.178	-1.545	.125
	LFRest_transformed	.651	.064	.648	10.220	.000
2	(Constant)	.901	.294		3.065	.003
	STAI_total	.005	.004	.181	1.328	.186
	Negative_emotionality	-.007	.004	-.201	-1.746	.083
	LFRest_transformed	.645	.063	.643	10.243	.000
	TASK_difficult_easy	.123	.045	.174	2.768	.006
	LOTR_opt	-.006	.012	-.049	-.485	.628
	LOTR_pes	-.001	.010	-.013	-.129	.897

a. Dependent Variable: LFTask_transformed

Recovery following task

107. SBP

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	1456.140	1048.972		1.388	.167
	BMI	-46.019	32.066	-.117	-1.435	.153
	STAI_total	-9.174	25.524	-.054	-.359	.720
	Negative_emotionality	15.819	29.009	.082	.545	.586
2	(Constant)	2230.456	1873.987		1.190	.236
	BMI	-33.370	32.306	-.085	-1.033	.303
	STAI_total	-20.396	30.490	-.120	-.669	.505
	Negative_emotionality	6.478	29.096	.034	.223	.824
	LOTR_opt	-156.000	87.094	-.242	-1.791	.075
	LOTR_pes	62.974	74.546	.112	.845	.400
	TASK_difficult_easy	509.293	332.757	.126	1.531	.128

a. Dependent Variable: SYS_AUC

108. DBP

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	1066.063	1084.549		.983	.327
	BMI	-32.957	33.153	-.082	-.994	.322
	STAI_total	18.672	26.389	.107	.708	.480
	Negative_emotionality	-10.950	29.993	-.055	-.365	.716
2	(Constant)	11.111	1938.271		.006	.995
	BMI	-43.724	33.414	-.108	-1.309	.193
	STAI_total	37.744	31.536	.216	1.197	.233
	Negative_emotionality	-3.744	30.094	-.019	-.124	.901
	LOTR_opt	124.515	90.082	.188	1.382	.169
	LOTR_pes	-9.019	77.103	-.016	-.117	.907
	TASK_difficult_easy	-646.182	344.172	-.155	-1.877	.062

a. Dependent Variable: DIA_AUC

109. MAP

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	1196.089	851.483		1.405	.162
	BMI	-37.311	26.029	-.117	-1.433	.154
	STAI_total	9.390	20.718	.068	.453	.651
	Negative_emotionality	-2.027	23.547	-.013	-.086	.932
2	(Constant)	750.893	1545.067		.486	.628
	BMI	-40.273	26.636	-.127	-1.512	.133
	STAI_total	18.364	25.138	.134	.731	.466
	Negative_emotionality	-.336	23.989	-.002	-.014	.989
	LOTR_opt	31.010	71.807	.059	.432	.666
	LOTR_pes	14.978	61.462	.033	.244	.808
	TASK_difficult_easy	-261.024	274.352	-.080	-.951	.343

a. Dependent Variable: MAP_AUC

110. HR

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	416.626	374.847		1.111	.268
	STAI_total	-2.846	14.531	-.030	-.196	.845
	Negative_emotionality	2.537	16.525	.023	.154	.878
2	(Constant)	-1147.317	1004.742		-1.142	.255
	STAI_total	8.992	17.423	.093	.516	.607
	Negative_emotionality	2.780	16.734	.025	.166	.868
	LOTR_opt	46.724	49.307	.128	.948	.345
	LOTR_pes	18.176	42.826	.057	.424	.672
	TASK_difficult_easy	258.346	190.932	.113	1.353	.178

a. Dependent Variable: HR_AUC

111. HF-HRV

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.812	.175		4.642	.000
	STAI_total	.001	.004	.022	.231	.817
	Negative_emotionality	-.006	.005	-.128	-1.346	.180
	HFTask_transformed	.790	.052	.786	15.123	.000
2	(Constant)	.918	.311		2.950	.004
	STAI_total	.001	.005	.016	.140	.889
	Negative_emotionality	-.006	.005	-.133	-1.373	.172
	HFTask_transformed	.800	.054	.795	14.906	.000
	LOTR_opt	-.007	.014	-.044	-.519	.605
	LOTR_pes	.004	.012	.025	.298	.766
	TASK_difficult_easy	-.048	.054	-.048	-.899	.370

a. Dependent Variable: HFRecov_transformed

112. SDNN

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	43.665	7.615		5.734	.000
	STAI_total	-.316	.262	-.145	-1.206	.230
	Negative_emotionality	.166	.299	.067	.555	.580
	SDNN_Task	.483	.053	.606	9.187	.000
2	(Constant)	43.814	18.445		2.375	.019
	STAI_total	-.373	.316	-.171	-1.183	.239
	Negative_emotionality	.253	.304	.102	.830	.408
	SDNN_Task	.489	.053	.614	9.153	.000
	LOTR_opt	1.068	.892	.128	1.197	.233
	LOTR_pes	-.942	.775	-.130	-1.214	.227
	TASK_difficult_easy	-2.369	3.510	-.046	-.675	.501

a. Dependent Variable: SDNN_Recov

113. LF-HRV

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	1.187	.214		5.552	.000
	STAI_total	-.004	.004	-.135	-1.167	.245
	Negative_emotionality	.002	.004	.053	.462	.645
	LFTask_transformed	.667	.065	.647	10.226	.000
2	(Constant)	.967	.299		3.234	.002
	STAI_total	-.003	.004	-.083	-.608	.544
	Negative_emotionality	.004	.004	.104	.906	.366
	LFTask_transformed	.694	.065	.674	10.625	.000
	LOTR_opt	.022	.012	.187	1.848	.067
	LOTR_pes	-.007	.010	-.071	-.709	.480
	TASK_difficult_easy	-.104	.047	-.142	-2.220	.028

a. Dependent Variable: LFRecov_transformed

Health behaviors and demographic differences between optimists and pessimists

114. Caffeine intake

Tests of Between-Subjects Effects

Dependent Variable: Caffeine_intake

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	.785[a]	3	.262	.509	.676	.010
Intercept	499.785	1	499.785	972.539	.000	.868
Opt_Pess	.759	1	.759	1.477	.226	.010
TASK_difficult_easy	.026	1	.026	.051	.821	.000
Opt_Pess * TASK_difficult_easy	1.824E-5	1	1.824E-5	.000	.995	.000
Error	76.057	148	.514			
Total	578.000	152				
Corrected Total	76.842	151				

a. R Squared = .010 (Adjusted R Squared = -.010)

115. Alcohol intake

Tests of Between-Subjects Effects

Dependent Variable: Alcohol_intake

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6.303[a]	3	2.101	1.623	.187	.032
Intercept	1287.559	1	1287.559	994.640	.000	.870
Opt_Pess	1.980	1	1.980	1.530	.218	.010
TASK_difficult_easy	4.158	1	4.158	3.212	.075	.021
Opt_Pess * TASK_difficult_easy	.211	1	.211	.163	.687	.001
Error	191.586	148	1.294			
Total	1489.000	152				
Corrected Total	197.888	151				

a. R Squared = .032 (Adjusted R Squared = .012)

116. Exercise

Tests of Between-Subjects Effects

Dependent Variable: Exercise_total

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	73.390[a]	3	24.463	1.277	.284	.025
Intercept	10421.436	1	10421.436	544.046	.000	.786
Opt_Pess	10.068	1	10.068	.526	.470	.004
TASK_difficult_easy	.138	1	.138	.007	.932	.000
Opt_Pess * TASK_difficult_easy	63.296	1	63.296	3.304	.071	.022
Error	2835.005	148	19.155			
Total	13320.000	152				
Corrected Total	2908.395	151				

a. R Squared = .025 (Adjusted R Squared = .005)

117. Perceived SES

Tests of Between-Subjects Effects

Dependent Variable: perceived_SES

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	10.533[a]	3	3.511	1.317	.271	.026
Intercept	5022.625	1	5022.625	1884.470	.000	.927
Opt_Pess	10.520	1	10.520	3.947	.049	.026
TASK_difficult_easy	.007	1	.007	.003	.959	.000
Opt_Pess * TASK_difficult_easy	.007	1	.007	.003	.959	.000
Error	394.460	148	2.665			
Total	5419.000	152				
Corrected Total	404.993	151				

a. R Squared = .026 (Adjusted R Squared = .006)

118.

Estimates

Dependent Variable: perceived_SES

Opt_Pess	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1.00	6.014	.190	5.638	6.389
2.00	5.487	.185	5.122	5.852

Chaos Theory

LOT-R score

119. SBP

Tests of Between-Subjects Effects

Dependent Variable: LOTR_tot

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3699.871[a]	6	616.645	38.063	.000	.612
Intercept	12732.808	1	12732.808	785.935	.000	.844
STAI_total	964.851	1	964.851	59.556	.000	.291
Negative_emotionality	2.705	1	2.705	.167	.683	.001
chaos_SBP	47.022	4	11.755	.726	.576	.020
Error	2349.122	145	16.201			
Total	60959.000	152				
Corrected Total	6048.993	151				

a. R Squared = .612 (Adjusted R Squared = .596)

120. DBP

Tests of Between-Subjects Effects

Dependent Variable: LOTR_tot

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3891.267[a]	6	648.545	43.582	.000	.643
Intercept	12823.487	1	12823.487	861.743	.000	.856
STAI_total	966.014	1	966.014	64.916	.000	.309
Negative_emotionality	.975	1	.975	.066	.798	.000
chaos_DBP	238.418	4	59.604	4.005	.004	.100
Error	2157.726	145	14.881			
Total	60959.000	152				
Corrected Total	6048.993	151				

a. R Squared = .643 (Adjusted R Squared = .629)

121.

Pairwise Comparisons

Dependent Variable: LOTR_tot

(I) chaos_DBP	(J) chaos_DBP	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1.00	2.00	1.208	.884	1.000	-1.312	3.728
	3.00	-.563	1.081	1.000	-3.644	2.517
	4.00	2.561	1.313	.530	-1.181	6.302
	5.00	3.686*	1.214	.028	.225	7.147
2.00	1.00	-1.208	.884	1.000	-3.728	1.312
	3.00	-1.772	.900	.509	-4.338	.794
	4.00	1.353	1.166	1.000	-1.972	4.677
	5.00	2.478	1.080	.232	-.600	5.555
3.00	1.00	.563	1.081	1.000	-2.517	3.644
	2.00	1.772	.900	.509	-.794	4.338
	4.00	3.124	1.323	.195	-.647	6.896
	5.00	4.249*	1.242	.008	.708	7.790
4.00	1.00	-2.561	1.313	.530	-6.302	1.181
	2.00	-1.353	1.166	1.000	-4.677	1.972
	3.00	-3.124	1.323	.195	-6.896	.647
	5.00	1.125	1.454	1.000	-3.020	5.270
5.00	1.00	-3.686*	1.214	.028	-7.147	-.225
	2.00	-2.478	1.080	.232	-5.555	.600
	3.00	-4.249*	1.242	.008	-7.790	-.708
	4.00	-1.125	1.454	1.000	-5.270	3.020

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

122.

Estimates

Dependent Variable: LOTR_tot

chaos_DBP	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
1.00	20.077[a]	.744	18.608	21.547
2.00	18.869[a]	.464	17.953	19.785
3.00	20.641[a]	.774	19.111	22.170
4.00	17.517[a]	1.074	15.394	19.639
5.00	16.391[a]	.970	14.474	18.309

a. Covariates appearing in the model are evaluated at the following values: STAI_total = 44.9868, Negative_emotionality = 37.3224.

123. MAP

Tests of Between-Subjects Effects

Dependent Variable: LOTR_tot

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3789.765[a]	6	631.628	40.539	.000	.627
Intercept	11661.270	1	11661.270	748.434	.000	.838
STAI_total	997.321	1	997.321	64.009	.000	.306
Negative_emotionality	.866	1	.866	.056	.814	.000
VAR00002	136.916	4	34.229	2.197	.072	.057
Error	2259.228	145	15.581			
Total	60959.000	152				
Corrected Total	6048.993	151				

a. R Squared = .627 (Adjusted R Squared = .611)

Task score

124. SBP

Tests of Between-Subjects Effects

Dependent Variable: Stress_Task_score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	112.291[a]	6	18.715	1.246	.287	.049
Intercept	119.741	1	119.741	7.969	.005	.052
STAI_total	3.551	1	3.551	.236	.628	.002
Negative_emotionality	3.612	1	3.612	.240	.625	.002
chaos_SBP	71.843	4	17.961	1.195	.315	.032
Error	2178.650	145	15.025			
Total	7799.000	152				
Corrected Total	2290.941	151				

a. R Squared = .049 (Adjusted R Squared = .010)

125. DBP

Tests of Between-Subjects Effects

Dependent Variable: Stress_Task_score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	71.732[a]	6	11.955	.781	.586	.031
Intercept	164.542	1	164.542	10.751	.001	.069
STAI_total	7.727	1	7.727	.505	.479	.003
Negative_emotionality	.211	1	.211	.014	.907	.000
chaos_DBP	31.285	4	7.821	.511	.728	.014
Error	2219.208	145	15.305			
Total	7799.000	152				
Corrected Total	2290.941	151				

a. R Squared = .031 (Adjusted R Squared = -.009)

126. MAP

Tests of Between-Subjects Effects

Dependent Variable: Stress_Task_score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	58.040[a]	6	9.673	.628	.708	.025
Intercept	152.291	1	152.291	9.889	.002	.064
STAI_total	3.499	1	3.499	.227	.634	.002
Negative_emotionality	2.140	1	2.140	.139	.710	.001
VAR00002	17.592	4	4.398	.286	.887	.008
Error	2232.901	145	15.399			
Total	7799.000	152				
Corrected Total	2290.941	151				

a. R Squared = .025 (Adjusted R Squared = -.015)